# REPORT

OF THE

# ADMINISTRATIVE CHAIRMAN

OF THE

# HONORARY ADVISORY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH OF CANADA

For the Year ending March 31, 1919

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OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1919

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OTTAWA, June 28, 1919.

The Right Hon. Sir GEORGE E. FOSTER, P.C., G.C.M.G.,
Chairman of the Sub-Committee of the Privy Council for
Scientific and Industrial Research, Ottawa.

SIR,—I have the honour of presenting to you my report on the work of the Honorary Advisory Council for Scientific and Industrial Research for the year ending March 31, 1919, as required by the terms of the Act (7-8 George V, Chap. 20) constituting the Council.

I have the honour to be,

Your obedient servant,

A. B. MACALLUM,

*Administrative Chairman of the Honorary Advisory Council for Scientific and Industrial Research.*

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The Honourable T. A. Crerar, *Minister of Agriculture.*

The Honourable Martin Burrell, *Secretary of State and Minister of Mines.*

The Honourable G. D. Robertson, *Minister of Labour.*

The Honourable L. A. Sifton, *Minister of Customs and Inland Revenue.*

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Douglas McIntosh, M.A., Sc.D., Professor of Chemistry and Head of the Chemical Department, University of British Columbia, Vancouver, B.C.

J. M. Turnbull, B.A.Sc., Professor of Mining and Metallurgy and Head of the Metallurgy Department, University of British Columbia, Vancouver, B.C.

## THE INDUSTRIAL FATIGUE COMMITTEE.

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E. A. Bott, M.A., Ph.D., Lecturer in Psychology in the University of Toronto, Instructor in the Military School of Orthopædic Surgery and Physiotherapy, Toronto.

Prof. D. Fraser Harris, Sc.D., M.D., Department of Physiology, Dalhousie University, Halifax, N.S.

Prof. A. P. Knight, M.A., M.D., Department of Physiology, Queen's University, Kingston, Ont.

John Lowe, Jr., Representative of Canadian Manufacturers' Association, Montreal Cottons, Limited, Valleyfield, P.Q.

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# REPORT

OF THE

# ADMINISTRATIVE CHAIRMAN

OF THE

# Honorary Advisory Council for Scientific and Industrial Research.

## I. GENERAL ACCOUNT OF THE WORK OF THE COUNCIL.

The work of the Council during the year has been greatly affected by the conditions under which it had to be carried on. The absence overseas of two of the members, Drs. Adams and McLennan, and the resignation of Professor Kirkpatrick and Mr. Bienvenu, imposed on the other members increased duties and responsibility, calling for more sacrifice of their time and energy. The operations of the Military Service Act greatly limited the supply of researchers, as many of these became engaged in military work either in Canada or overseas. In consequence a number of special researches which were projected were not undertaken owing to the impossibility of obtaining the services of researchers specially qualified for attacking such problems. In other cases it was impossible to get the material necessary for the conduct of the investigations involved. As a result of all these handicaps, the programme of special researches to which grants of money were proposed or considered had to be curtailed.

Even the supply of students for the Studentships and Fellowships instituted by the Research Council was less than in the previous year. Of the twenty-five of such Studentships and Fellowships only four were awarded before October first, the beginning of the Academic Year, and when the Armistice was signed three more were awarded to students who, serving in the military forces in Canada, were released and accordingly began the term of their Studentship after January 1.

Even in the case of investigations for which the Council gave grants of money to assist in the carrying on of these there was a difficulty in getting the necessary scientifically qualified technical assistants.

Though greatly handicapped because of the scarcity of scientific researchers, the absence of two members and the resignation of two others, the Council has made progress along a number of lines of activity, as will be presently shown.

1. *The meetings of the Council and of its Committees.*—During the year ten meetings of the Council were held and monthly, with the exception of August and September, which the Administrative Chairman spent in visiting centres in the Maritime Provinces for the purpose of getting into touch with conditions there. Eight of these meetings were of two days' sessions, and with one exception were held in Ottawa. One of the ten meetings covered four days, during which sessions were held, not only in Ottawa, but also in Montreal and Toronto for the purpose of discussing with the authorities of McGill University and the University of Toronto the measures which should be taken to increase the facilities to be offered to those holding the Studentships and Fellowships of the Council who desire to pursue their courses of graduate study and research at these universities. This was in accordance with the

programme of the Council, which entails also visits to the other Canadian universities to urge them to provide, if possible, similar facilities for such students.

A considerable part of the work of the Council was done by committees, and a large number of meetings of these were held during the year. The work of the majority of these was of special industrial interest, covering such questions, among a large number, as the utilization of fish waste, of the sugar of the sulphite liquor of our pulp mills, industrial alcohol, patents, the establishment of a Central Information Bureau for the natural resources of Canada and the preparation of a compact and succinct handbook of the chemical industries of the Dominion.

A meeting of the Associate Committee on Chemistry was held in Ottawa on May 20 and 21, and was attended by fourteen of the seventeen members of the Committee. A large number of subjects of interest to the chemical industries of Canada were discussed, among which were:—

1. The utilization of waste liquors of pulp mills.
2. Industrial alcohol.
3. The tar sands of Alberta.
4. The utilization of titaniferous iron ores.
5. The utilization of waste straw for gas production.
6. Co-ordination of the scientific work of the departments of the Government.
7. The granting of patents to Government employees.
8. The need of a central bureau for research.
9. A census of the chemical industries of Canada.

A meeting of the Associate Committee on Mining and Metallurgy was held in Montreal on March 4 and 5, with an attendance of thirteen members, several of whom came from the extreme east and extreme west of Canada. An abstract of the proceedings of this meeting is given in Appendix " B."

The British Columbia Advisory Committee, to which, in response to recommendations of the Associate Committee on Mining and Metallurgy passed at its meeting in March, 1918, the Administrative Chairman proposed for inquiry a number of subjects concerning the mineral resources and industries of British Columbia, more especially the economical possibilities of producing iron and steel in that province, presented a report, dated November 28, which is given in Appendix " C." This report is of special interest as affecting the question of the capacity of that province to produce iron and steel, not only for use in British Columbia, but also for export.

2. *Expenditures of the Council.*—The parliamentary vote for the year was $120,000. Of this only the sum of $61,151.62 was expended. The programme of the Council, as already explained, was curtailed by the scarcity of trained researchers required for investigations for which grants to meet the expenses to be incurred were contemplated. The estimated expenditure under this head was $60,000. As a large number of these were accordingly not undertaken, only a small part of this was expended. Another factor in limiting the expenditure was the small number of Studentships and Fellowships awarded. The amount actually spent for this purpose was only $7,150, whereas the estimated expenditure was $17,000. The total amount spent for salaries of the staff and the outlay for office work amounted to $22,520.88.

3. *Assisted Researches.*—The applications for grants in aid of special researches were, for reasons indicated, few as compared with those of the previous year. The staffs of the scientific departments of the universities were depleted by the engagement of a large number of their members in war work in Canada, or engaged in military services overseas, and there were available practically no scientific researchers outside the universities and higher technical institutions. This imposed a policy of carrying on as the situation determined, and only those researches were assisted for which the necessary researchers could be found. Some of these were such as had been assisted in the previous year, others, that, for instance, on the tar sands of Alberta for which a grant was provided, lapsed as they did in the previous year for want of investigators to carry them on.

In spite of the handicap experienced in the lack of researchers some effective work was done. The investigation of the reduction of iron ores by gases, under the supervision of Professor Stansfield, of McGill University, has advanced to a stage which promises important results bearing on the utilization of ores of low grades so abundant in Canada. There is but a small supply of high grade iron ore in the Dominion, which is emphasized by the fact that 96 per cent of all the iron ore smelted in Canada is imported, this importation including, of course, that obtained from Belle Isle, Newfoundland.[*] The total quantity of high grade iron ore on the Globe available is, through its use for producing iron and steel, diminishing at a rate which makes its exhaustion a not far distant event, and in consequence it will eventually be necessary to turn to those of lower grades for the supply of ore for the industry. If the smelting could be effected on an industrial scale at a reduction in the cost which would offset the disadvantages at present attendant on the utilization of these lower grade ores it would make available, immediately or in the very near future, the immense quantities of such ores in Canada. The Research Council regards the solution of this problem as of very great importance to Canadian industry and as justifying a protracted experimental investigation carried on on a large scale.

The investigation on Wheat Genetics carried on for the past two years, and for which the Research Council made last year a substantial grant, has already given very interesting results. It may be explained that amongst the risks to which wheat growing in the three western provinces is exposed are early frost and the rust fungus. The Marquis Wheat, the origin of which is a very noteworthy achievement resulting from the experiments in wheat breeding on the part of Dr. Charles E. Saunders, of the Experimental Farm, Ottawa, is the staple wheat of the West, and is rapidly becoming the staple wheat of the Northwestern States. It gives a large yield, it has good milling and baking qualities, which are exceedingly valuable factors in making it acceptable as a wheat suitable for cultivation in the West. It ripens earlier than the other varieties, which it has almost wholly displaced, but not so early as to escape the incidence of an early frost. Further, it has a comparatively low power of resistance to rust, which, in some districts, takes a heavy toll on the crop. Professor Thompson, in his investigations, is attempting to breed a variety of wheat which will ripen early, be wholly rust-resistant and have good milling and baking qualities. He has succeeded in producing a variety which ripens nearly two weeks earlier than the Marquis, and also varieties some of which are wholly rust-resistant, others less so. He is now endeavouring to produce a hybrid of these which will ripen early, be completely rust-resistant, give a good yield per acre and have the right milling and baking qualities. The achievement of this object is fraught with consequences of vast importance to agriculture in Western Canada, as it will eliminate all the ordinary risks, except one, namely, deficiency of rainfall, to which wheat growing there is subject, and the Research Council, recognizing what is involved and the agricultural interest concerned, is prepared to support financially this investigation till the object of it is attained, even if it takes a number of years to achieve it. It has already made a very substantial grant to continue the work during the season of 1919.

A grant of $2,000 was made to provide for an investigation on the causation of the discoloration of canned lobster. Of the annual output of the lobster canneries of the Maritime Provinces a large number of the cans are found immediately or ultimately with the contents darkened or blackened and the inner surface of the tin in such cans is covered wholly or in part with a rustlike deposit. This results in an annual loss to the industry of many thousands of dollars. To what this discoloration is due has been variously explained but almost wholly as of purely chemical origin, yet the explanations advanced have not in the slightest degree assisted in suggesting measures to prevent the discoloration. Recently it has been found by Miss J. MacFarlane, M.A., who, under the auspices of the Biological Board, worked in the summer of 1918 at the Biological Station at St. Andrews, N.B., and during the last winter in the botanical department of the University of Toronto, that the affected cans examined by her had in every instance a bacterial flora which the unaffected cans did not have. Whether a generalization as to the causation of the discoloration may be drawn from these results must be determined only after further extended investigation. If the causation should definitely prove to be bacterial in character the measures to be taken to counteract it would be comparatively simple and would involve only thorough sterilization of the cans after they are hermetically sealed.

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[*] The quantity of high grade iron ores in Canada is limited and a large part of it is in British Columbia. The amount in sight there is placed at 14,000,000 tons and there may be in addition, approximately, twice that or about 40,000,000 tons in all. (*Vide* Bulletin No. 2, University of Washington Bureau of Industrial Research: "An Investigation of the Iron Ore Resources of the Northwest." By W. H. Whittier, Seattle, published by the University, 1917).

That there are other factors involved is not yet wholly excluded. The discoloration of the contents of the cans is accompanied, though not always, by a discoloration or rustlike incrustation of the internal surface of the cans. As this discoloration of the tin, so far as present observations go, never appears without a discoloration of the contents, it would appear as if it were due to the effect on the tin of products of the action of bacteria on the contents, but the fact that in some of the spoiled tins there is no incrustation indicates either that the bacteria concerned are not all of the same species, or that the surface of the tin plate used in making the cans varies greatly in its capacity to resist chemical action. That there is a variety in this respect in the tin plate used seems to be indicated by the results of investigations carried on by the staff of the Research Laboratory of the American Canners' Association, but whether this generalization can be applied to the tin plate used in the canning of lobsters can only be determined by special investigation.

As the lobster canning industry is one of considerable importance to Canada, and as its success depends on a high grade of product, a thorough and prolonged research on the problems affecting the industry should be systematically planned and carried out. The grant made for this investigation is for preliminary investigations. It is expected that when the Fish Canners' Guild for Research is fully organized it will undertake to continue and support this investigation. The guild, the formation of which was agreed upon at a meeting, held in Amherst in December, of a large number of those engaged in the industry, will include not only such, but also a number of those who are concerned in the fish industry.

A grant of $7,000 was made to the Biological Board of Canada to provide for researches on the chemistry and bacteriology of fish curing and its products. The value of these products in Canada is about six millions of dollars and accordingly but a fraction of the total annual yield of the fisheries. It would be much greater were it of a character which would encourage the consumption of the product. A portion of it is excellent in quality, but the remainder of it is by no means up to the standard of the British, Norwegian, Danish, or Dutch products. This is due to the use of methods which have had a vogue in the trade for a century and therefore of a purely empirical character, but carried out with a lack of care as to essentials that makes the product an inferior or less desirable one. Some of the methods also are quite repulsive in character, although the product may pass muster as to appearance and, in some cases perhaps, as to taste.

It is urgent that all these methods should be either wholly discarded and replaced by others, or greatly improved, in order that the production and consumption of cured fish should be increased beyond that which obtains to-day in Canada. To replace some of the methods or improve others it is necessary to know more about the chemistry and bacteriology of the cured product than is known now. Little work has been done in a systematic way in research in this line. A careful study of the bacterial flora of fish and cured fish has yet to be made and the effects of the various agents, creosote and other compounds in smoke and the salt, used in pickling for example, on fish muscle are only imperfectly understood. The bactericidal action of creosote on fish muscle and its capacity to penetrate in order to exert this action adequately are as little known. Further, the possibility of substitute methods and of other agents which may be more effectively used should be investigated. These are amongst the problems which must be solved before the industry can be placed on basis which will promote a greater development of it in Canada. The Biological Board will, it is understood, arrange for two series of investigations, one along chemical, the other along bacteriological lines, each to be placed in charge of investigators specially qualified for this work.

4. *The Utilization of the Low Grade Lignites of Western Canada as domestic fuel.*—In the Report of the Administrative Chairman for 1917-18 a full account was given of the question of utilizing the low grade lignites of Saskatchewan to provide a domestic fuel to replace the anthracite which was in previous years imported into Western Canada from Pennsylvania to the extent of over half a million tons annually. The Research Council recommended that the Government of the Dominion make an appropriation of $400,000 to erect a carbonizing-briquetting plant capable of turning out 30,000 tons of briquettes practically equivalent in thermal value, pound for pound, to anthracite, the sum asked for to provide also for the operation of the plant for a year. After an extended consideration of the proposal, the Government, in co-operation with the Governments of the provinces of Manitoba and Saskatchewan, agreed to make the appropriation required, and decided to put the conduct and control of the experiment in charge of a board, which was appointed on the 22nd of August, 1918. This board, known as "The Lignite Utilization Board," is composed of three members, who give their services without remuneration, and who are Mr. R. A. Ross, of Montreal, as Chairman; Mr. J. M. Leamy, of Winnipeg, and Mr. J. A. Sheppard, of Moosejaw. This board met in Montreal on September 16, 1918, and organized to undertake a thorough and comprehensive attack of the problem of utilizing these lignites. It is expected that the preliminary tests will be completed in October or November of 1919, and if the results prove satisfactory the erection of a commercial plant to carbonize and briquette the lignites will be undertaken before the spring of 1920.

An interesting account of the work done by the Lignite Utilization Board up to the end of March, 1919, is to be found in Appendix "E," the author of which is Mr. Lesslie R. Thomson, the Secretary of the Board.

5. *Industrial Alcohol.*—A number of modern lines of industries are dependent on a cheap form of alcohol known as industrial alcohol. Industrial alcohol is very largely ethyl or "grain" alcohol, mixed with some substance which will render it unpotable, but not unfit for the use to which it may be put industrially. The substances the addition of which renders ethyl alcohol unpotable and which are, therefore, called "denaturants," are very numerous, but the uses to which "denatured" alcohol may be put limit the number to a few, such as wood alcohol (methyl alcohol), benzol, pyridine bases, bone oil, etc., and of these wood alcohol is the most common denaturant, giving with ethyl alcohol a mixture known as "methylated spirits," consisting approximately of 10 parts of ethyl alcohol of 95 per cent strength to every one part of methyl alcohol.

Denatured alcohol is very extensively used abroad as a chemical agent, a precipitant, a solvent, a cleaner, in many industrial processes, especially in the chemical industries, and it is also used as a motor fuel to replace gasoline and for illumination purposes. The importance of it in these lines is seen in the fact that the quantity of industrial alcohol used in Germany is very great, amounting in the year ending August 31, 1904, to 101,823,470 gallons, while the consumption of denatured alcohol in the United States for 1913 was 16,953,353 proof gallons, and for 1918 90,644,722 proof gallons. This latter limit was reached by greatly increasing annual consumption since the first of January, 1907, when the manufacture and sale in the United States of denatured alcohol was freed from the restrictions which up to that date had been imposed on it. The consumption before 1907 had been about 1,500,000 gallons annually.

Cheap alcohol is a necessity for a large number of lines of industry and the extent of the consumption of it in a country is an index of the development of its industries, especially the chemical. The large amounts annually used in Germany and the United States are, therefore, significant of the value of cheap alcohol.

In Canada the consumption is a meagre one. It was only 252,000 proof gallons in 1917. If it had been in proportion to the population as compared with the United States the amount would have been in the neighbourhood of 5,000,000 proof gallons, or about twenty times as much as it was.

One of the reasons for this very limited consumption is the cost, a very important contributory factor to which is the conditions under which the denaturation is carried out by the Department of Inland Revenue. All the alcohol so used has to be shipped to Ottawa from the distillery where it is produced and after it is denatured it is shipped to customers. The charges for transportation to and from Ottawa do not matter greatly if the distances involved are small, but when these reach 500 miles and may in some cases exceed 2,000, the charges are a serious tax and tend to discourage the use in industry of denatured alcohol.

Another factor is the present high price of alcohol, due to the bonding system, which requires that alcohol shall be kept in bonded warehouses for two years before being sold to the trade. Much of the present supply in Canada has been in bond for considerably more than two years. This involves interest on the buildings and plants used for this purpose and for that time on the original cost of the alcohol so stored. This can to a certain extent be justified for alcohol that is to be used to produce beverages therefrom, for during this storage there is a gradual alteration, or disappearance, of certain of the accompanying compounds which are more toxic and harmful than pure alcohol is. For industrial purposes, however, freshly distilled alcohol is as effective and serviceable as alcohol which has been allowed to age and consequently it would be considerably cheaper than the latter.

The current price of matured ethyl alcohol in Canada is due to the restrictions referred to, to the high cost during the last three years of corn and other raw material used to produce it. The wholesale price of alcohol of 95 per cent strength at the time of this writing is $7.43 per gallon, which includes the excise duty of $3.96. The distiller then receives about $3.47 per gallon, while the wholesale price of ethyl alcohol of 95 per cent strength in the United States is from 50 to 55 cents per wine gallon.

The alcohol used to make denatured alcohol and the ethyl alcohol used for industrial purposes must, therefore, be, and is, at present supplied from recently distilled spirits which are manufactured to-day in Canada by only two firms whose maximum capacity for production is annually about 8,000,000 proof gallons, but whose output at present is not more than a third of that. The limited supply is due to the limited market in Canada and this is due, again, to the conditions imposed on the production and use of denatured spirits. In consequence, denatured alcohol costs 95 cents a gallon in Canada as against 60-62 cents per gallon (imperial measure) in the United States.

Even the wholesale price of American alcohol is higher than it was in 1914 because of the higher price of corn from which it is made, and so long as the supply of food for the world is scarce, or not abundant, as is the case to-day, the price of alcohol will remain approximately as at present. If, however, other raw materials not foodstuffs, and not used for any object, could be employed in the production of alcohol, the price might eventually be considerably reduced. The waste molasses of the sugar refineries was and is employed for this purpose, but the amount available in Canada is not very large. There is one waste material which in Canada and the United States has not been so used, namely, the sulphite liquor of our numerous pulp mills. Enormous quantities of this are produced annually in Canada, and it is being and has been disposed of by pouring it into the streams and rivers, poisoning all fish and other life therein. It contains ½ per cent of fermentable sugar, from which in the liquor of the pulp mills in Norway and Sweden more than 1,000,000 gallons of ethyl alcohol are produced annually. It has been estimated by Professor R. F. Ruttan, who has given much attention to this subject, that the sulphite liquor of the three pulp mills on the St. Maurice River would, if utilized for this purpose, produce annually about 640,000 gallons of alcohol of 95 per cent strength and at a cost of under 35 cents a gallon. It has also been estimated that the sulphite liquor of all the pulp mills in Canada is sufficient to produce at least 5,000,000 gallons annually, that is, enough to supply the needs of Canada for the next twenty years. Perhaps the cost per gallon may be reduced when the resinous and other non-sugar constituents of these liquors, amounting to about 8 per cent of the same, are put to some practical use, not thrown away as now. They are to a certain extent already utilized in tanning and the resinous material, "sulphite pitch", has been suggested as a binder in briquetting slacked coal, and, indeed, it has been used to a small extent for that purpose.

Another kind of raw material for the production of alcohol is wood waste in all its forms, including slabs, strips and sawdust, from saw-mills. The quantity of this annually destroyed, or allowéd to decay, is enormous, especially in British Columbia, where it is estimated between five thousand and fifteen thousand tons of wood are burnt daily to get rid of it. As the saw-mills of Eastern Canada operate only about five months in the year, and, further, the collection of their waste is difficult, the utilization of it for making alcohol is not regarded as economically feasible as yet, but in British Columbia the only possible difficulty is the extent of the market for alcohol. The conversion of wood waste into alcohol is carried on elsewhere. At Georgetown, S.C., and at Fullerton, La., are plants in which the Tomlinson process for the conversion of wood waste into alcohol is employed. A description of this process is given by Mr. G. H. Tomlinson, which appears as Bulletin No. 7*. It is possible that this process might be employed in the Pacific coast province, especially if a portion of the waste is used to make glucose, which can be mixed with hay and other fodder to make special cattle foods.

The use of denatured alcohol as motor fuel to replace gasoline is not a remote possibility. The annual consumption of gasoline is increasing and the price per gallon of it is mounting, as new sources of supply do not meet the increasing demand for it. It is, indeed, claimed that the world's supply of gasoline will be exhausted within thirty years. Whether this is so or not, it is clear that the price is going to increase, and this will necessitate the resort to other liquid fuels as serviceable, or nearly so, and amongst these is denatured alcohol. The only handicap to its use is the price. If industrial alcohol could be produced cheaply it would quickly replace gasoline, for it could, with slight changes in the motor engine, be as effectively used. A pound of gasoline will give on combustion about 18,960 B.T.U's, while a pound of alcohol of 95 per cent strength gives 10,355 B.T.U's, and accordingly one gallon of gasoline should as a source of power go as far as 1.54 gallon of alcohol, but the actually efficiency of gasoline is less than this, and therefore industrial alcohol at 30-35 cents a gallon, a not impossible price in the near future, should successfully compete with gasoline at 50-55 cents per gallon, a price that will be reached and exceeded in a few years. Alcohol was produced in Germany before 1914 at a cost of 20-24 cents a gallon, which could not compete with gasoline at 30 cents.

A survey of all the facts concerning gasoline and alcohol as motor fuels makes it almost an absolute certainty that alcohol, denatured for the purpose, will be the motor fuel of the near future. It can be made from materials now considered waste and yet inexhaustible, while the supply of gasoline, unless made synthetically, will become exhausted. As the supply approaches exhaustion the price will rise and alcohol will then, if cheap, take its place as fuel.

Cheap alcohol should be provided not only for its service as motor fuel, but also for the development of Canadian industry. With methylated spirits to-day at 60 cents per gallon in the United States and at $0.95 in Canada, the handicap on Canadian industry is apparent. The necessity of cheap alcohol has been emphasized by the various bodies interested in Canadian chemical industries and especially by the Canadian Branch of the Society of Chemical Industry and by the Associate Chemical Committee of the Council. As a result of the representations of these and other bodies on the question of industrial alcohol, the Research Council gave prolonged and careful consideration to it and formulated recommendations to the Sub-Committee of the Privy Council, which are summarized as follows:—

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* "The manufacture of Ethyl Alcohol from Wood Waste." By G. H. Tomlinson. Bulletin No. 7 of the Honorary Advisory Council for Scientific and Industrial Research.

1. That the production of denatured ordinary alcohol, such as methylated spirits, be carried out at any distillery licensed to that end and under such regulations as the Minister of Customs and Inland Revenue may prescribe and that the denatured alcohol so manufactured be sold, duty-free, delivered and transported without any restriction to dealers, manufacturers, and other persons.

2. That the manufacture of specially denatured alcohol, that is, alcohol which is to be used for the production of some chemicals, ether, chloroform, etc., and for which a special denaturant is required, be permitted under regulations prescribed by the Minister of Customs and Inland Revenue in distilleries licensed thereto and sold duty-free to the manufacturers of such chemical preparation.

3. That pure ethyl alcohol without admixture with any denaturant shall be sold duty-free for use in the manufacture of such products as require the use of such alcohol as a solvent, precipitant or agent, under regulations to be prescribed by the Minister of Customs and Inland Revenue.

4. That pure ethyl alcohol be sold duty-free, under such regulations as the Minister of Customs and Inland Revenue may prescribe, to incorporated hospitals, to universities, and to scientific and research laboratories.

5. That the recovery of alcohol by distillation after its used be allowed in the plant in which it was used, under such regulations as may be prescribed by the Minister.

A bill embodying these recommendations was prepared under the supervision of F. H. Gisborne, K.C., accepted by the Acting Chairman of the Sub-Committee and adopted in effect by the Acting Minister of Customs and Inland Revenue and it is incorporated in the Bill, No. 76, entitled "An Act to amend the Inland Revenue Act," which is now before Parliament.

6. *On the right of Government Technical Employees to patent processes discovered by them.*—The question of allowing Government employees to patent technical processes discovered by them in the course of their work was brought to the attention of the Research Council in 1917 by a committee of representatives of the staff of the Department of the Interior associated with the Forest Products Laboratory under that department, asking that it be made permissible for technologists to take out such patents. It was pointed out that when a technologist in the service of the Government discovers, while carrying out technical work or research as part of his duties, a new process, or some mechanical device, which, when applied in industry, is of commercial value, he may resign his post in order to be in a position to take out the patent for it in his own name, and as a consequence the staff is continuously losing many of the best of its technologists and researchers, and to prevent this loss the technical officers should be granted the right, unquestioned under certain conditions, of patenting such discoveries and inventions.

The difficulty at present in the way is not in any regulation or Act of Parliament barring this right, for there is none, but the absence of any express regulations or indication of policy in regard to such matters is a deterrent to the would-be patentee. Unless the department concerned is definitely known to be favourable to granting a patent in a particular case the application for it will not be made because it might be refused, in which case the facts of the discovery or invention would be published to the injury of the applicant's interest. The very uncertainty, varying in degree with the different departments, is in effect as prohibitive as a regulation or statute forbidding the granting of such patents.

It must be admitted that the discoveries and inventions made in the course of his duties by an official of one of the Government departments, which pays for his whole time service, should belong to the Government and be free of use to any citizen of the state, which provides the revenue from which his salary is paid. This ideal, however, can never be realized. Salaries in the Government service, even in the positions requiring on the part of their occupants highly special technical qualifications, are low. To achieve discoveries and inventions requires more than unselfish enthusiasm, for they demand time and a steady effort that will tax the utmost patience of the worker. If the state is not discerning of such service and accordingly does not fitly reward it, why should the worker concern himself with more than his routine duties? Ability will seek the field where the rewards for its exercise are the greatest, or it will not excel mediocrity in achievement.

To stimulate effort and achievement in the scientific departments of the Government service and to keep in that service technologists and researchers of the highest ability, special rewards for such effort and achievement must be offered. Promotions in rank, or increases in salary are rarely possible because of the Civil Service Act, and bonuses from the treasury are inadvisable, as well as difficult to adjust, because the value of a new process or invention can only be determined after it has been tested in the industry where it may be utilized, and several years may pass before this result is reached. There remains, then, the question of allowing the discoverer or inventor to patent his new process or mechanical device under such conditions as will safeguard the interest of the public as well as that of the inventor or discoverer.

The law and the practice in the United States are not consistent. While the Federal Patents Law allows government employees (excepting those of the Patent Office at Washington) to take out patents on their inventions, in certain bureaus of the Government service the employees must assign their inventions and the rights to their processes to the Government outright; in others they are prohibited from taking out any patents; in others, if they may take them out, they must assign them to the public, and in others again they may obtain patents, but the Government reserves the right of free license thereunder. In some instances of the last class this free license is restricted to the bureau in which the invention or new process was discovered and is denied to other branches of the Government service.

The regulations of the British Government, as a rule, permit the departments concerned to take out patents, and in the application therefor the discoverer or inventor participates. In the Admiralty the inventor must obtain permission from his commanding officer, or the head of his department, to apply for a patent before making such application. The inventor must obtain permission from the Admiralty to apply for a patent in any foreign country or British overseas dominion or state. In regard to the action to be taken for Great Britain, there are three alternative courses which are adopted by the Admiralty.

1. It may be assigned to the Admiralty and the inventor will not be allowed to dispose of the commercial uses of his patent if it has any.

2. The Admiralty may be satisfied with an agreement giving the Government and its contractors the right to use the invention or patent, but otherwise leaving the inventor free to dispose of his invention or patent for commercial purposes.

3. The Admiralty may find no use for, and therefore has no interest in, the invention or patent, in which case it leaves the inventor to dispose wholly of his invention or patent as he chooses.

The Research Council, after very full consideration of all the facts, as the foregoing shows, came to the decision that in the matter of allowing employees in the technical branches of the Government service to take out patents on processes discovered or mechanical devices invented by them in the course of the performance of their duties, the permission to do so could be accorded under conditions that would not conflict with public interest. The necessity of granting this permission as a right is an urgent one. It is the only way at present feasible of keeping a number of highly qualified technical men on the staff. Promotion in rank or increases in salary for those making such discoveries and inventions cannot in many cases be affected for reasons already referred to. There is no difficulty involved in allowing the privilege of patenting the discoveries and inventions. It will stimulate effort and encourage ability to achieve its utmost and the service will thereby be made more efficient. Further, if the Government is assigned a share in the interest of each patent thus granted the result from all points of view should be eminently satisfactory.

The commercial value of a patent in Canada, except, perhaps, in a very few lines, the pulp and paper industry for instance, is low as compared with its value in the

United States. In determining the conditions under which a patent is permitted to a Government employee, this fact should be taken into account. The patent rights for abroad, including the United States, should belong to the inventor or discoverer, as has been recognized hitherto, for there was no regulation preventing a Canadian Government employee from obtaining patent in Great Britain and the United States. If now this right is recognized by statute it would be an equitable adjustment of the interests of the Government and the employee if at the same time half of the rights in each patent for Canada is conceded to the Government, the other half going to the discoverer or inventor.

This solution of the question was finally approved by the Research Council, which formulated the result in the following resolution conditionally:—

That experts in the Government service be allowed to patent in their own name their discoveries and inventions provided they assign half of their patent rights in Canada to the Government of Canada—the proceeds from the royalties of which to be devoted to the support of scientific research—the rights outside of Canada to be retained by the patentees.

Copies of this resolution were addressed to the deputy ministers of the various departments which have technical staffs, for the purpose of eliciting their views on the principle embodied in it. It was on the whole favourably considered by them, and, with one or two exceptions, by those to whom they referred the matter.

After further consideration, the Research Council decided to recommend to the Sub-Committee of the Privy Council for Scientific and Industrial Research that legislation be passed giving effect to this resolution. This the Sub-Committee approved of, and Mr. O'Halloran, the commissioner of patents, in consultation with representatives of the Research Council and of the departments above referred to, drew up a Bill embodying the changes recommended by the Council. A copy of a portion of this Bill is given in Appendix "N." It is hoped that this Bill will receive the sanction of Parliament during the current session.

It is to be understood, let it be said again, that the discoveries and inventions of technical officers in the Government service for which the proposed legislation makes provision are only those which are made or developed in connection with the technical work of such employees and in the laboratories or scientific establishments of the Government.

The necessity for such legislation is recognized elsewhere and especially in connection with the Government services at Washington. As already pointed out the practice in the various Departments there, regarding the granting of patents to technical employees varies from Department to Department. In consequence uncertainty prevails because of which initiative and inventive genius are discouraged amongst Government employees and the Government services suffer accordingly. To remedy all this a committee composed of members of the various Scientific Bureaus in Washington, which carefully studied the situation, prepared a draft of a Bill which was submitted to Congress in February of this year. A copy of this draft is given in Appendix "O".

The question of allowing the technical employees of the Dominion the right to patent their discoveries or inventions under equitable conditions is an urgent one and the solution proposed above should be given sanction by Statute at an early a date as possible.

7. *The Utilization of Fish Waste in Canada.*—The question of the utilization of fish waste has been under the consideration of the Research Council for the last eighteen months. The annual amount of this waste in Canada for both the Atlantic and the Pacific coasts was estimated to be about 300,000 tons by Mr. J. B. Feilding who was employed by the Council to make a survey of both coasts to report on the subject. Only at several points was any attempt made to dispose usefully of it and to a very limited extent. A firm at Canso converts the waste derived from the operations of the Maritime Fisheries Corporation plant there into a brand of glue and another at Anse à Beaufils in Gaspé, under the management of Mr. M. A. Wick, is utilizing that which is gathered in the vicinity, to separate the oil for the preparation of fishliver oil for the foreign market. From the salmon canneries at New Westminster, B.C., and the immediate vicinity the fish offal is transported to Seattle, Washington, for reduction there into animal food, oil and a fertilizer.

In Norway and Sweden and in Germany before 1914, and in the United States fish waste was systematically utilized and the product figured considerably as a source of revenue in the fish industry. In Germany a select portion of it was made to serve as a source of food for human consumption but the greater part of the products consisted of oil and a residue employed to mix with other material (hay, milling offal, etc.) to furnish stock food. In Gloucester, Massachusetts, and at points on the Pacific coast of the United States are plants which convert the product into food for hogs, cattle and poultry, the oil derived therefrom going on the market chiefly to serve for the manufacture of soap.

The value of the fish waste in Canada, if utilized as it is elsewhere, would be very great. The quantity of solids in the three hundred thousand tons annually thrown away, and comprising chiefly fats and proteins is at least one fourth of that amount and if subjected to appropriate treatment it ought, at the prices which prevail, and have prevailed, for the last four years, to be worth $10,000,000 or about one fourth of the annual yield from the fisheries of Canada. The oil, contained in this waste should, if separated and purified, be worth on the market as much as $2,000,000.

This fish offal is produced at a great number of points along both coasts, but more abundantly on the Eastern coast, where the quantity, according to Mr. Fielding's estimate, reaches 240,000 tons. The remoteness of many of these points and the consequent difficulty and cost of collection at central reduction plants of the offal in time to prevent deterioration are serious handicaps in a commercial utilization of the material. Another factor is the shortness of the season during which the offal is produced. On the Pacific coast it is approximately six weeks, while on the Atlantic it does not exceed seven months, and consequently reduction plants would have to be idle during a considerable portion of each year.

There are other difficulties attendant upon the utilization of the offal. The processes employed hitherto are of the experimental stage, and the results have not been always satisfactory. The separation of the fat or oil is carried on by the action of hot water and steam on the minced or ground-up material, the oil collecting on the water as it leaves the mass. This does not by any means remove all the fat, and therefore the residue which should consist mainly of proteins is fat-containing and to a considerable extent. This difficulty intruded itself in the operation of the dog-fish reduction plants at Canso and Clarke's Harbour, N.S. To utilize dog-fish for the production of oil and fertilizer these plants were operated under the auspices of the Department of the Naval Service, but are now closed owing to the failure to make them pay. The residue could not be directly used as a fertilizer because the oil contained therein on decomposition in the soil "soured" it and rendered it more or less unproductive. To dry it the residue was roasted, which caused, however, a loss of a considerable part of its fixed nitrogen, and it was thereby and proportionately to the degree to which the roasting had been carried out less valuable as a fertilizer. For the preparation of a good animal food also the separation of the greater part of the oil is necessary, as the presence of it to any considerable extent in the food tends to give a "fishy" taste to the flesh of the animal fed on it.

The more or less imperfect character of these and other methods of the treatment of fish waste has deterred ventures into this line of industry, and in consequence the fundamental work on which success in it must be based has still to be done.

The utilization, however, of this waste will be of imperative urgency in very near future. Even now there is a very serious deficiency in the world's supply of food, including specially fats. It will take twenty years at least to restore the annual supply to what it was before 1914, and, therefore, any source of protein and fat at present untapped should, if it is all industrially feasible, be made to contribute its quota of these indispensaible nutrient compounds. The proteins so obtained would, mixed with other foods less nourishing, give a product which, as stock food, would enhance the supply of meat of various kinds, beef and pork, while the fat could be employed to the extent of its supply in the production of the cheaper and commoner kinds of soap for which so much of more valuable fat is used to-day. The consideration of the question of taking measures which might lead to the utilization of fish offal for this purpose ought not to be postponed if there is at all a possibility of employing the waste economically.

The Council, on the recommendation of Professor R. F. Ruttan, Chairman of its Associate Committee on Chemistry, gave full consideration to this question. It collected data on the subject and appointed Mr. J. B. Feilding, who had, in 1915, under the auspices of the Conservation Commission, carried out demonstrational work in this line in a provisional plant at Port Stanley, to make a tour of a number of centres in the United States for the purpose of gathering information regarding the utilization of fish waste elsewhere. The Council ultimately came to the conclusion that a project for the utilization of the offal could be successfully carried out, and that the results would blaze the way to the development of a new line of industry in Canada which would ultimately involve an output of several millions of dollars annually.

There are centres along the Atlantic coast where the quantity of fish offal readily collectible at comparatively low cost, from nearby points, is very considerable and where consequently it is possible on an adequate scale to test the commercial feasibility of a selected process for the treatment of the offal. Such a centre is Canso, N.S., where the quantity of offal accessible daily during the season is at least thirty tons and may be increased, at need, to double or treble that amount. If it was decided to erect a plant for this purpose it was clear than Canso would be the most suitable location for it.

A consideration of all the facts and the information which the Council had gathered on the subject led it to conclude that the utilization of fish waste was an industry which could be made to give profitable returns, and that it was necessary only to demonstrate this on a modest scale by the installation of a plant and the operation of it for a year or so, in order to induce private companies or firms organized for that purpose to undertake this utilization. To provide this demonstration it recommended to the Sub-Committee of the Privy Council for Scientific and Industrial Research that an appropriation of $50,000 should be made to carry on this demonstration for one year under a commission which would control the equipment of the necessary plant and its operation for that period. It was recommended that the equipment be installed in the disused lobster hatchery at Canso, which could be granted for this purpose, and, further, that one of the steam trawlers at the disposal of the Government, and for part of the year not on duty in the fishery service, be available for the collection of the fish waste in the locality and even for catching by trawling of such kinds of fish of the vicinity, skate for example, as are not at present used for food.

These recommendations were also advanced to the Reconstruction and Development Committee of the Privy Council, and were under consideration by that Committee when it developed that the project might be undertaken and carried on by private enterprise. Eventually Mr. J. S. Myers, President of the Peerless Cereal Milling Company of Woodstock, Ontario, organized a company with a considerable amount of capital, which purchased the lobster hatchery from the Department of Fisheries and is now installing in it the necessary machinery and equipment. One of the Government trawlers, or drifters, is, it is understood, to be placed at the service of the company for a limited period in order to provide for the collection of the fish waste and the catching of fish, of the class not used as food. Mr. Myers proposes to use the plant for the production not only of fish oil, but also for the preparation of protein material suitable for mixture with the offal of cereal mills to make special cattle food.

The results of this undertaking will, it is hoped, serve to encourage other ventures of a like character elsewhere, eventually leading to a complete utilization of a very large part of the present amount of fish waste.

The Research Council proposes to give further attention to the utilization of fish waste, because it considers that the last word has not been said either in regard to the processes now followed in this utilization or to the character of the product. The processes involve biochemical problems of a highly intricate nature and the solution of these must greatly enhance the success of the utilization. It may be pointed out, incidentally, that in this utilization cheap industrial alcohol must prove a very valuable factor.

8. *Recommendations regarding the establishment of a National Research Institute for Canada.*—The Research Council early in 1918, as shown in the last report of the Administrative Chairman, after full consideration of the question of the right organization to provide for systematic research on the natural resources of Canada and on the problems which concern the development of Canadian industries, came to the conclusion that this organization should be that of a national research institute, constituted to deal with standards of all kinds, like the Bureau of Standards at Washington and to have also the function of providing facilities for research carried on and maintained by associations or guilds for research formed in the various lines of industry.

Since then the council has placed before the Sub-Committee of the Privy Council for Scientific and Industrial Research, and the Reconstruction and Development Committee of the Government, a report recommending the establishment at the earliest possible date of such an institute and that an appropriation of $500,000 be made for a building, of the laboratory type, for such institute to be erected on a fifty-acre site near Ottawa and further that $100,000 for its scientific equipment and $100,000 for salaries of the staff during the first year be also provided. The memorandum embodying this report is reproduced in Appendix " J." The report has been accepted by the two committees but has not as yet been approved by the Government. The subject is now under consideration by a special committee of the House of Commons appointed " to consider the matter of the development in Canada of scientific research, with power to call for persons, papers and records, to examine witnesses under oath and to report from time to time."

The question of establishing such a National Research Institute is discussed in Section II.

The Council has given consideration to the question of the control of this Institute which, it holds, should be vested in the Research Council and subject to approval and supervision of the Sub-Committee of the Privy Council for Scientific and Industrial Research. In support of that may be adduced the results of past experience in the matter of direct government control of scientific organizations and the precedents created elsewhere in the case of national research institutes, as, for example, the National Physical Laboratory of Great Britain, the National Research Institute of Japan and the proposed Institute of Science and Industry for Australia, a Bill to establish which is now before the Parliament of the Commonwealth (Appendix " P "). The control of the National Physical Laboratory of Great Britain was vested in the Royal Society which appointed a board of which the President of the Society was the chairman and the executive committee of which constituted the real governing body of the Laboratory. Under the new provisions for the future control of the laboratory this control is still to be exercised by the President and Council of the Royal Society as indicated in the Appendix to the Report of the Executive Committee for 1918 and reproduced as Appendix " Q." The budget of expenditure of the Laboratory will be met, as for the last three years by grants from the Government Department of Scientific and Industrial Research.

To indicate in as concrete a form as possible the views of the Research Council as to the provisions it recommends for the control of the proposed National Physical Laboratory a draft of a Bill to establish this Institute, to be offered for the consideration of the Government is reproduced in Appendix "K". This draft is the result of a long and careful consideration by the Research Council.

9. ***Research on Industrial Fatigue.***—In modern industry the question of the efficiency of the worker in relation to the hours of labour in conjunction with the amount of his output and the conditions under which he operates is one to which a great deal of attention has been given in Great Britain, France and the United States, especially during the last four years because of its bearing on production in munition factories. It is a question also which is likely to become enhanced in importance in the near future, for not only does it concern the efficiency of both industry and labour, but it affects also in a large measure the social welfare of all the industrial population. In consequence, organizations were launched in Great Britain and the United States, nearly a year ago, to investigate industrial fatigue in the various lines of industry in a systematic and thoroughly scientific way and already data have been obtained which are of the very greatest value in relation to hours of toil and output in some trades. The results of investigations henceforth to be conducted on comprehensive scale are, it is believed, likely to constitute the final criteria for establishing optimum conditions for industrial efficiency and welfare among the industrial workers in those countries.

Although very much of what may be won from these investigations will be found applicable everywhere, there are some special conditions in Canada, those, amongst others, arising from differences in climate and to a certain extent in food, the operation of which may serve to qualify in some degree the conclusions which may result from the investigations now being carried on by the British Industrial Fatigue Board and under the auspices of the Federal Public Health Service at Washington. This makes it appear advisable that an organization to carry out similar work in Canada should be created, for, although the industrial population of the Dominion is not a large one, a large industrial development is projected and accordingly, we should be ready to advance abreast with the other nations along these lines and obtain whatever benefits may result from it.

The main problems themselves are very largely of a physiological character, but, because mental and nervous factors are also concerned in bodily fatigue, a study of them must involve observations in the fields of experimental psychology. Further the investigations undertaken must have the approval of those whom they immediately concern, the workers on the one hand and the industrial managements on the other. As also the number of women workers in Canada is not negligible, their interests in such an invstigation should be represented by some one or more who have given special attention to women as industrial toilers.

The Research Council in view of all these considerations decided in February to appoint a committee to investigate Industrial Fatigue, composed of a number of the leading Physiologists in our Canadian Universities, one or more specially qualified experimental Psychologists, representatives of the Trades and Labour Council of Canada and of the Canadian Manufacturers' Association and one or two women representative of, and conversant with, the question relating to female labour in industry.

This committee constituted along the lines just indicated has been recently appointed by the Council. It has been organized under the chairmanship of Professor J. J. R. Macleod of the University of Toronto and it has issued a circular letter to the leading industrial firms in Canada, indicating the objects of the committee and asking for suggestions as to the lines of work in which each could co-operate with the committee. As soon as the replies to these circulars are received it will proceed to undertake such inquiries on the subject of Industrial Fatigue as may appear likely to give results of value.

The Committee will also endeavour to co-operate with similar organizations abroad in order to prevent duplication of effort.

10. *Forestry Studies.*—The work undertaken in 1917 by the Forestry Branch of the Department of the Interior with the object of obtaining data regarding the rates of growth in volume of our more important timber trees, notably the white pine and spruce, and the possibilities and successful methods of securing their reproduction, and to which extended reference is made in the Administrative Chairman's Report for the year ending March 31, 1918, was continued on the cutover area of the Petawawa Reserve last season and a large number of data were obtained which are of great value in determining the lines along which these Forestry Studies are to be conducted in the future.

The results already obtained from this survey have enabled the Forestry Branch to elaborate a system of forest organization which is specially adapted to the conditions which in Eastern Canada and which permit the inauguration of the best silvicultural practice to provide efficiently for reforestation.

In the comprehensive report of the work carried on for last season prepared by the Forestry Branch of the Department of the Interior, a summary of which is given in Appendix "D," it is pointed out that if the organization of the Petawawa Military Reservation is completed and the tract placed under permanent management a concrete example of the value of intensive organization in forestry conservation will be continually available for Canadian lumbermen. It is also urged in that report that if the Government can develop such a system and make it a financial success lumbermen should not hesitate to adopt in the management of their own areas a similar system of intensive organization for conservation of their lumber supplies.

The expenses involved in these investigations under the control of the Forestry Branch were met by a grant from the Research Council amounting to $6,214.57. A grant has been made to cover the expenses of the investigation for the season of 1919.

The Research Council regards these investigations as of fundamental importance in determining the data which must be ascertained regarding the rates of growth in volume and the possible quantity of reproduction of our more valuable timber trees, in order that a comprehensive and successful attack on the problem of reforestation in Eastern Canada be undertaken. Without such data it will be impossible to take any effective measures to prevent the exhaustion of our lumber supplies, especially of white pine and spruce.

11. *The Establishment of Bursaries and the Provision for Training Research Students in Canada.*—Early in 1917 the Council recognized the fact that there is a very limited number of highly trained researchers in Canada and that it was necessary to increase the supply of such if the application of research to Canadian industrial problems is to be successfully fostered. To accomplish this object more quickly, it established twenty Studentships and five Fellowships, with the understanding that the numbers of both should be increased when the supply of candidates for them should be sufficient to justify this action.

The cardinal qualification of a candidate for a Studentship is the possession of initiative and independent action in prosecuting research on some special scientific problem, a qualification the possession of which he can demonstrate only by having carried on to a successful termination a research of some distinction. He must, indeed, have also other qualifications. He must, for example, be a university or college graduate, with a special knowledge of the science to research in which he is to devote himself and have a good general knowledge of the cognate sciences. These are, however, not in themselves enough, for without the initiative and the capacity for independent thought no student may ever become a researcher.

The Fellowships are awarded to those who, as holders of Studentships for one or two years, or independently, have shown in a high degree capacity for research.

Now the demonstration on the part of any candidate for a Studentship, of his capacity for research, implies a year or so spent in post graduate study, during which he must attempt some research work. As a rule there are few of those who have just graduated in a position to afford the additional expense and consequently they may be unable to qualify for Studentships. The Council decided to institute Bursaries, ten in number, for such to be awarded for 1919-20 to as many graduates whose attainments in science and whose expressed aims are such as to justify their being awarded such Bursaries. A Bursary, which is $500 in amount, is tenable only for a year, and if the holder of one during that time demonstrates the possession of a capacity for research he will be awarded a Studentship for the following year.

The regulations governing the award of these Bursaries are given in Appendix "F."

It is hoped, with the aid of these Bursaries, to select amongst the best of each year's graduates, in science, of the universities those who may develop into excellent researchers, but who without such help may be unable to obtain the necessary preliminary qualification for entering a career of scientific research. The fact that such Bursaries will be available at graduation to distinguished students will be a spur to ambition to excel, and the thoughts of many of them will be turned to the possibilities of a scientific career. That will eventually bring a return in value to the country far exceeding the amount spent in such Bursaries.

So much for Bursaries, Studentships and Fellowships. Where are, however, the holders of these to receive the special training which they require? The question is not very immediately urgent for the twenty to twenty-five students, fellows, and holders of Bursaries can be accommodated in four or more of the leading Canadian universities, but if, as is contemplated, the number of Studentships and Fellowships is increased to fifty, and, ultimately, to one hundred, where are these to be trained? Already the Scientific Departments of one of the leading universities are taxed to the utmost to accommodate those students and fellows who have elected to work therein and the accommodation and facilities of another is or will be soon, engaged to the same extent. Shall the excess be sent to the universities of the United States or of Great Britain? To ask this question is to answer it in one respect. It is, however, a problem the solution of which depends on the adoption of a policy demanding the recasting of some of the present aims of our leading universities and a very considerable increase in their resources to make the revised aims effective. The kernel of this problem is the fact that not one of our leading universities is staffed and equipped in science to compare with any one of the ten leading American universities.

12. *Central Information Bureau.*—There is in certain Departments of the Dominion Government and of the various Provincial Governments a large amount of information regarding the natural resources of Canada which is not readily available to those who may desire data regarding the character and distribution of one or more of these resources in the Dominion, with the view to undertaking their development. The inquirer may be forced to go from department to department in Ottawa to get the information he seeks, but in the end may find it also necessary to go to the provincial capitals to complete it, and in consequence a lot of time is thus wasted, which is a handicap and a deterrent to enterprise. The Council believes that the facilities for obtaining readily all this information should be provided in some bureau in Ottawa, organized for this purpose, in which all the data regarding the natural resources available, published or contained in manuscript, documents or memoranda, in the various Dominion and Provincial Government Departments should be pooled, as it were, in a form that will permit an inquirer regarding a subject to ascertain what is known concerning it in a few hours. The Organization Committee of the Council has approached certain of the Departments for the purpose of initiating amongst them a movement to bring about at an early date the establishment of such a Bureau of Information regarding the Natural Resources of Canada.

In this connection the Associate Committee on Mining and Metallurgy passed the following resolution:—

> "Whereas, in the present critical period of industrial readjustment and expansion it seems most important that all information concerning national resources which has been so painstakingly gathered by Government Departments in Ottawa should be quickly and completely available to responsible inquirers planning to build up various industrial enterprises based on the exploitation of these resources; and
>
> "Whereas, such information necessary for the development of a single enterprise often lies in the records of more than one of the Government Departments, so that vexatious and dangerous delays frequently occur in the collection of the necessary data for important projected developments;
>
> "Resolved, by the Associate Committee on Mining and Metallurgy of the Honorary Advisory Council of Scientific and Industrial Research that it is highly necessary that a Central Information Bureau should be established by the Government in Ottawa wherein all the different departments should co-operate to make readily available complete up-to-date information regarding all the natural resources of Canada except those relating strictly to agriculture."

13. *Affiliation with the British Research Council.*—During the past year the Research Council has been in relation with the British Research through attendance at its meetings, as assessors, of Professor J. C. McLennan, O.B.E., F.R.S., and Professor F. D. Adams, F.R.S., members of the Canadian Research Council who have been engaged overseas, the one in directing research work under the Admiralty, the other in directing university courses of instruction for students in the Canadian Army in England and France. Through this connection the Research Council has received the benefit of the experience, on a number of important matters, of the British Council, and it desires to express its appreciation of the privileges accorded its representatives by the latter.

## II. THE ESTABLISHMENT OF A NATIONAL RESEARCH INSTITUTE FOR CANADA.

In the report of the Administrative Chairman for 1917-18 the question of the establishment of a Central Research Institute for Canada was discussed at considerable length and the results were summarized in the following extract therefrom:—

"In consideration of these facts which are advanced to show the general agreement as to the urgency for each state to provide for organized research by the establishment of institutes or bureaus for research to assist the development of the industries of each, and also because of the special need in Canada of one such, the Research Council has approved of the proposal that a Central Research Institute be established at the earliest possible date, whose functions will be that of carrying on research not only in pure science in relation to standards of measurements, quality and composition of material, but also in science applied to the industries of Canada."

The Council has had this question under consideration at every meeting held since that report was published and every aspect was thoroughly discussed. It is a question which cannot be ignored, or lightly considered, or postponed, and in consequence it felt that it was necessary to emphasize the urgent need of a Research Institute which would play the part in Canada of a great organization for research like the Bureau of Standards at Washington, or the National Physical Laboratory at Teddington near London. The Council believed that the establishment of a Central or National Research Institute would constitute a factor of overwhelming importance in determining the development of scientific and industrial research in Canada, and that this development must be provided for before anything else in order to enable the Dominion to carry the burden of debt which the war has imposed on it. The Council was of this view over a year ago but it now believes that the question of instituting the proper form of organization to guide research in Canada on its resources and their right and adequate utilization transcends in importance any other question that is before the public to-day.

In view of all this the Council desires to emphasize the necessity of determining what this organization should be. It should be adapted to do what it is designed to achieve. A failure in that respect would entail a double penalty, for not only would resources for the purpose be wasted but, what is more important, the time lost would be irreparable. Several years spent in an unprofitable experiment would put the Dominion behind several decades in the world competition and rivalry in trade and manufacture and, therefore, any scheme of organization that is adopted must be constituted to secure certainty in the attainment of its object.

The Council is strongly of the opinion that the primary and essential part of any organization that should be established would be a National Research Institute which would have as its function not only those of a Bureau of Standards but also those of an institute like the Mellon Institute at Pittsburgh Pa. An institute with such functions would meet the most pressing requirements for the development of our natural resources and make provision for assistance to the industries of Canada in the way of applying the most advanced scientific methods to increase, cheapen, and improve production. It is only in this way that Canada can acquire the means to meet her obligations and consequently the functions referred to are of cardinal importance.

The Council formulated its report on this subject to the Sub-Committee of the Privy Council and to the Reconstruction and Development Committee of the Cabinet in a document which is reproduced in Appendix "J". It recommends the establishment of a National Research Institute for Canada, with the functions as indicated below, located near Ottawa where city water supply and electric power are available and on a site of at least 50 acres to provide space for subsequent expansion and also for additional laboratories which may be required in experimental work on a semi-commercial scale. The building to be provided for on this site should be of the laboratory type, of four stories in addition to basement and of dimensions 200 by 60 by 70 feet in which, besides corridors and office and administration quarters, there would be at least 50 laboratory units of 25 by 25 feet dimensions. This would suffice for immediate needs and for a number of years.

The cost of this building which should be of solid (or steel) construction with cement floors and including heating plant, power equipment, the ventilating outfit, and the water, gas and drainage plumbing, would, it is estimated, be $500,000. The scientific equipment of the building, including the scientific instruments required in the various lines of investigation which would be undertaken, would approximate $100,000. The salaries would require $100,000 per annum for the first few years but only a part of this would be needed during the first year and one of the first appointments made should be that of the Director in order that the plans of construction may be carefully supervised and adapted to the work which the institute may be called upon to do.

The functions in detail of this institute should be:—

(*a*) The investigation and determination of standards and methods of measurements, including length, volume, weight, mass, capacity, time and heat, light, electricity, magnetism and other forms of energy; and the determination of physical constants and the fundamental properties of matter.

(*b*) the standardization of the scientific and technical apparatus and instruments for Government service and for use in the industries of Canada, and of the materials used in the construction of public works;

(*c*) the investigation and standardization of the materials which are or may be used in the industries, and of the products of the industries;

(*d*) researches undertaken with the object of improving the technical processes and methods used in the industries and of discovering new processes and methods which may promote the expansion of the existing industries or the development of new Canadian industries;

(*e*) researches undertaken to promote the utilization of the natural resources of Canada.

The institute also should have charge, direction or supervision of the researches which may be undertaken by or for single industrial firms under conditions to be determined in each case, or by such organizations, to be known as Trade Guilds for Research, which may be formed in the various industries with the view of improving the processes of production or the products of those industries, as may desire to avail themselves of the facilities offered for this purpose by the institute.

Such a National Research Institute would have all the functions of a Bureau of Standards and it would provide, as indicated in the foregoing paragraph, free accommodation, light and heat in its laboratory units for the research staffs of those co-operative associations for research formed in the various lines of industry, known as Trade Guilds for Research, which choose to avail themselves of such accommodation on conditions to be determined in each case. It would give the various lines of industry, at a cost which they could afford to pay, opportunities for the application of research to their problems the results of which would enable them to meet the foreign competition in their home markets and permit them to develop and maintain markets for their products outside Canada. It would encourage co-operation for research amongst the firms in each line of industry, to avoid failure or the compulsion to fuse with larger firms which would lessen competition and create powerful trade organizations and combines. There are very few individual firms in Canada, that can provide enough funds to undertake research each on its own problems with the hope of obtaining commensurate results. The rest cannot annually provide, perhaps, on the average, more than would pay the salary of a stenographer but with all such in a particular line of industry co-operating and pooling their funds for research, the Guild for Research so formed, would be in position to profit greatly, if its research staff were housed in one of the laboratory units of the institute and carried on research there under the supervision of the highly qualified technical staff of the institute. Each guild would thus be assured of results of value beyond what its limited resources would otherwise assure it. The free accommodation offered it would be in lieu of very direct financial assistance, such as that given by the Imperial Department of Scientific and Industrial Research to the Trade Associations for Research formed in the same way in Great Britain, a large number of which receive a grant from that department sometimes as much as pound for pound of their own funds. The number of such Trade Associations for Research formed, and in the process of formation, so far number twenty-five and the number of companies involved exceed eight houndred. The majority of these Trade Associations equip and maintain their own laboratories.

An institute with the functions of determining such standards as are referred to above, is urgently needed in Canada. There is no organization that even in a minutely fractional degree meets that need. At present the standardization of scientific apparatus, such as thermometers, pyrometers, electrical supplies and of quality in raw material and manufactured products is done for Canada almost wholly by the Bureau of Standards at Washington. That is the nearest testing house for this purpose and because of that it is resorted to intermittently and unsystematically, whereas if there were one in Canada its very activities, directed to the service of the industries of Canada would in a few years engage the interests of all these and give their products a grading that would make them acceptable in markets abroad. The age of standardization in manufactured products of all kinds is near at hand and to-day foreign governments are preparing for it, purposely in some instance, unconsciously in others, by the establishment of institutes or laboratories to determine standards.

The Dominion Government should, therefore, establish at as early a date as possible a National Research Institute with the functions as outlined. It is necessary to perform a function which private organization or institutions cannot, by reason of its magnitude, perform. It will be of an immense service to the industries of Canada in enabling them to meet successfully the pitiless competition in manufacture and trade in which the great nations must and will engage to pay their debt charges and replenish their resources so seriously reduced by the war.

The state can no longer be indifferent to the necessity for nationally organized research in science. Scientific research is to be henceforth all important in the development and maintenance of national prosperity and it is the State only which can provide for it adequately. The organization required should be what experience abroad has indicated and it should be begun on a more or less modest scale but on a plan that will permit expansion as required. The establishment of a National Research Institute along the lines indicated would accordingly be the first step in the inauguration in Canada of a policy which will ultimately provide for the fullest scientific development of all her resources to enable her to face the future and all its perplexities with some degree of equanimity and prepardness.

## APPENDIX A.

### ABSTRACT OF THE PROCEEDINGS OF THE FIRST MEETING OF THE ASSOCIATE COMMITTEE ON CHEMISTRY OF THE HONORARY ADVISORY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

This meeting was held on May 20, 1918, in Ottawa.

Fifteen out of the eighteen members of the Associate Committee were in attendance. Dr. R. F. Ruttan, the Chairman, presided. The sessions were also attended by Dr. A. B. Macallum, Administrative Chairman; Dr. A. S. Mackenzie, member of the Advisory Council, and Dr. A. McGill, Chief Analyst of the Department of Inland Revenue.

The Chairman gave a brief account of the organization of activities of the Advisory Council, referred to the Studentships and Fellowships instituted by the Council and the various assisted researches. He mentioned that no fewer than 87 questions had been submitted from manufacturers and others. A list of these questions is appended. These inquiries have been largely answered, but many of them required special investigation.

The first regular paper on the programme was given by Dr. John Bates, of the Forest Products Laboratories, on the "Utilization of the Waste Liquors of Pulp Mills for the Production of Ethyl Alcohol and Toluol from Sulphite Turpentine." He pointed out that the process as worked out in other countries gave a yield of about 0·7 per cent of alcohol by volume of the sulphite liquor waste and the process was a comparatively simple one. He pointed out that the turpentine in the wood was largely converted into cymene. A recovery plant for the turpentine of a mill would not cost more than one hundred or two hundred dollars. The average yield was about ·75 U.S. gallons for one ton of sulphite pulp which yields about ·45 U.S. gallons of Toluol per gallon of crude cyamene.

Mr. Wardleworth read a paper on industrial alcohol, its preparation from materials other than foodstuffs and the importance to the industries of the country to have it manufactured and distributed free of duty. After a very full discussion, in which nearly all the members of the Committee took part, together with Dr. A. McGill, who was present to represent the Department of Inland Revenue, the following resolution was unanimously passed:—

> "Whereas the fact that alcohol for industrial purposes, free of duty, has contributed much to the prosperity of several countries, and as Canada has a number of distilleries now lying idle, and as new processes are now available for making alcohol from non-edible materials, and as the Dominion has an unusual opportunity of extending its industries in many directions, and as a new source of motor fuel is desirable, and as alcohol is not now an unimportant source of revenue,
>
> Be it resolved that the Government be petitioned to permit the use of duty-free alcohol, subject to restrictions which would protect revenue and public safety."

Dr. A. F. L. Lehmann gave an account of the occurrence and value of the Tar Sands deposits of Alberta. The Committee made several suggestions regarding lines of investigation, demonstrating the commercial value of these tar products.

Dr. W. L. Goodwin gave an account of the new methods which were now being tried in order to utilize titaniferous iron ores, of which there are enormous beds throughout Canada. In Eastern Ontario alone there are millions of tons which cannot be utilized by present methods. Dr. Goodwin described certain experiments that had been carried on with a view of preparing pure titanic acid and valuable titanium salts, and also methods for recovering vanadium from ores carrying this material.

Dr. MacLaurin gave an account of his research on the "Utilization of Waste Straw for Gas Production." He pointed out that the gas so obtained had a value of about 400 B.T.U's per cubic foot and that 1,000 to 1,500 cubic feet of gas could be obtained in one operation lasting not longer than thirty minutes. He was investigating at that time the various forms of steel which would be used for the retort.

Dr. Birchard, Research Chemist for the Dominion Grain Laboratory, pointed out the value of introducing a small amount of casein into war bread and bread for the soldiers, increasing in this way, very cheaply, the nutritive value of the bread. After discussion it was resolved to bring this matter before the Food Commission, with a strong recommendation that it be carefully investigated.

At the evening meeting of the Committee, Dr. Bates introduced a discussion regarding the best methods of bringing about co-ordination of the scientific work of the various departments in Ottawa and the advisability of allowing scientific investigators engaged in Government work to patent their inventions. The following resolution was passed after a very thorough discussion, in which the policies of other governments was explained:—

> That experts in the Government service be allowed to patent in their own names their discoveries and inventions, provided they assign half of their patent rights in Canada to the Government of Canada, to be devoted to scientific research—the rights outside of Canada to be retained by the patentee."

At the request of the Chairman, Dr. Macallum, Administrative Chairman of the Research Council, brought up for the Committee's consideration, the advisability of establishing in Canada a Central Research Institute analogous to similar organizations which were to be found in Great Britain, United States, Germany, France, Italy and Japan.

Dr. Ruttan pointed out the advantage to the universities of the country and to research in general which would result from the establishment of such a bureau.

Dr. Goodwin expressed a view that the research work should be carried on chiefly in the universities with liberal endowment by the Dominion Government.

Dr. Ellis pointed out the necessity of the universities confining their functions to fundamental matters connected with science, rather than the industrial applications of science.

Dr. MacLaurin, Dr. McGill, Dr. Bates, and several other members of the Committee thoroughly endorsed the general principle of the establishment of a Central Research Institute.

Dr. F. M. G. Johnson pointed out the advantage of a concise inventory of the Canadian chemical industries, their locations, raw materials they use, their products and by-products, so that it might be possible to make a chemical map of Canada. He contended that those in control of the industries of Canada involving chemical processes were for the most part ignorant of what was going on elsewhere in the country. It was decided to prepare a census of the chemical industries of Canada along lines suggested by Dr. Johnson and that this should be carried out by co-operation between the Society of Chemical Industry, which had already some years ago prepared such a census of the industries, and the Bureau of Statistics at Ottawa.

Dr. Ellis brought forward the question of the establishment in Canada of Fellowships in connection with the Ramsay Memorial Fund which England and the various parts of the Empire were now engaged in collecting. The Honorary Advisory Council was requested to interest themselves in the project. It was decided also to bring the matter before the Conference of Canadian Universities and the Royal Society of Canada.

### LIST OF QUESTIONS ANSWERED BY THE ASSOCIATE CHEMISTRY COMMITTEE.

The following questions were received during the year and answered by the members of the Committee on Chemistry with the help of others. Some of them required much time and lengthy correspondence. Over sixty inquiries received the attention of the Committee:—

Composition of gums used on envelopes and stamps.
Condensation of acetylene to benzene.
Utilization of crude argols from the manufacturing of grape juice.
Value of carbon from peat.
Separation of potash salts from certain springs in New Brunswick.
Utilization of saw dust in New Brunswick.
Manufacture of cocoanut oil from copra.
How toluene can be prepared from Cymene and turpentine of pulp mills.
The Grillo process for the manufacture of sulphuric acid.
How to improve the manufacture of fly paper glue.
Use of substitutes for cane sugar in ice cream.
Uses of casein from milk refuse.
How to make a waterproof glue for out door use.
Effect of boiled oil in improving the value of sole leather.
Commercial sources of rare earths for gas masks.
How potassium salts can be obtained from shale used in brickmaking.
Value of alloys of lithium.
Commercial value of an alloy of copper with other metals.
Opinion on value of salts found in a lake in Alberta.
Fibres used in making gas mantles.
Food regulations regarding use of glucose and saccharin.
Manufacture of nitro-cellulose from pulp.
Potassium salts from cement works.
Poison in rubber sealing bands for preserve jars.
Manufacture of picric acid directly from benzene, using nitric acid and mercury.
The kind of kilns in use for burning lime with wood.
Occurrence of radium in waters above Banff.
Utilization of statical electricity for the removal of seeds of weeds from clover, alfalfa, etc.
Amount of cane sugar refined in Canada and crude sugar employed.
Could beet root be grown profitably in Canada?
How to produce smoke signals.
How to make an adhesive that will withstand alcohol and petrolic spirit.
How sandpaper is made.
Manufacture of milk substitutes, chocolate and other food products from soya beans.
Production of oil from walnuts.
Plant required to manufacture anhydrous ammonia.
A stabilizer for an emulsion of oil and milk powder.
How to manufacture aluminum from clay.
The market for acetic acid and sodium bichromate in Canada.
Cause of rancidity of oil in sardines.
Enamelling finish on cement.
Over twenty letters regarding methods of utilization of fish waste and waste fish.
Application of a radio condenser for detecting and indentification of bodies of ore, etc.
How to clean iron-stained granite.
Where to procure hydrogen gas in Canada.
Manufacture of methyl chloride as a refrigerating agent.
Utilization of confiscated opium as a source of morphine.
Value of mixed bessemer slag and ground feldspar as fertilizer.
Where to obtain good iron oxide paint in Canada.
Value of citric acid-soluble potash as a fertilizer.
The course of deterioration of white shellac.
Manufacture of flowers of sulphur from iron pyrites.
Should chlorine be grouped with bromine and iodine and placed on the free list for importation.
Utilization of calcium bimalate (sugar sand).
What are the substitutes for turpentine.
Manufacture of wood veneer and process of veneering.

## APPENDIX B.

## REPORT OF THE ASSOCIATE COMMITTEE ON MINING AND METALLURGY.

This Committee was organized in the autumn of 1917 but it was impossible to get its members together until March 5, 1918, when two very interesting meetings were held at the Windsor hotel, Montreal, prior to the annual meeting of the Canadian Mining Institute. Seventeen out of a total of twenty-five members were present, and a number of valuable suggestions were submitted to the Advisory Council.

Unfortunately, the Chairman of the Committee, Dr. F. D. Adams, F.R.S., went overseas soon afterward and the Vice-Chairman, Prof. S. F. Kirkpatrick, resigned from the Council, but in spite of these drawbacks the work outlined at the meeting was largely accomplished, although no further meetings were held during the year.

The second annual meeting was held in Montreal on the 4th and 5th of March, 1919, again in connection with the annual meeting of the Canadian Mining Institute. Three sessions in all were held, with an attendance of thirteen members. Owing to the fact that the chairman was still overseas, Dr. A. B. Macallum, Chairman of the Research Council, acted as convener and presided at the first session, at the close of which Dr. J. B. Porter was appointed Acting Chairman to hold office until the return of the chairman.

The following brief statement of the work of the Associate Committee to date may prove of interest.

(1) *Research Council.*—At each meeting a report on the work of the Council was submitted by the Chairman and discussed at length with a view to giving the Council the benefit of the views of the Mining and Metallurgical interests as represented by the Associate Committee.

(2) *Lignite.*—The work of the Lignite Utilization Board was also laid before the committee in the form of a report personally submitted by the Secretary, Mr. Leslie Thompson, and was similarly discussed.

(3) *Peat.*—It has been recommended that the excellent work done by the Dominion Department of Mines on peat and peat products be extended, and a special committee has been formed to take up this matter. The report of this Committee has been received and is being prepared for distribution.

(4) *Iron Ores.*—A Sub-Committee under the chairmanship of Mr. J. G. Morrow has been formed to consider the Canadian ore situation and to recommend such further investigations and developments as may seem advisable. This Committee is now studying the subject and an early report may be expected.

(5) *Refractory Material.*—A sub-committee on Refractories under the chairmanship of Mr. Theo. Denis has been formed, with especial reference to Canadian magnesite and other suitable materials. This committee may be expected to report at an early date.

(6) *Powdered Coal.*—A Sub-Committee under the chairmanship of Mr. O. E. S. Whiteside has been formed to consider the question of the use of Powdered Fuels, and to make recommendations as to the expediency of having special investigations carried out under government auspices, instead of leaving the matter as at present solely to private enterprise.

(7) ***Committee on Co-ordination of Effort.***—A Sub-Committee on Co-ordination was appointed to make recommendations from time to time as to work which it would be advisable for the Associate Committee to undertake.

(8) *Local Committees.*—The members of the Associate Committee were asked to constitute themselves into local committees in the several mining districts to inform the Main Committee as to matters of local interest which required investigation.

(9) *Natural Resources Bureau.*—The question of the advisability of establishing an Information Bureau on the Natural Resources of the Dominion was discussed, and it was resolved that:

> Whereas, in the present critical period of industrial readjustment and expansion it seems most important that all information concerning national resources which has been so painstakingly gathered by Government Departments in Ottawa should be quickly and completely available to responsible inquirers planning to build up various industrial enterprises based on the exploitation of these resources, and
>
> Whereas, such information necessary for the development of a single enterprise often lies in the records of more than one of the Government Departments so that vexations and dangerous delays frequently occur in the collection of the necessary data for important projected developments;
>
> Resolved, by the Associate Committee on Mining and Metallurgy of the Honorary Advisory Council of Scientific and Industrial Research that it is highly necessary that a Central Information Bureau should be established by the Government in Ottawa, wherein all the different departments should cooperate to make readily available complete up-to-date information regarding all the natural resources of Canada except those relating strictly to agriculture.

(10) *Reference Libraries.*—The Committee called attention to the importance of getting together reference libraries in the various centres of industry and recommended that such libraries, or, in their absence, catalogues of reference books already available in public and private libraries should be placed at the disposal of all persons interested in research.

(11) *Standard Reagents.*—The Committee called the attention of the Department of Mines through the Advisory Council to the importance of being able to obtain in Canada standard reagents and standardized samples for metallurgical analysis. Early action has been promised in this matter.

(12) *Steel Making in British Columbia.*—At the suggestion of the members from British Columbia it was recommended that the advisability of establishing a local steel industry in that province be considered. This has been done by the British Columbia Government, and a printed report covering the matter is now available.

(13) *Utilization of Sawdust.*—The possibility of utilizing the immense quantities of sawdust produced in British Columbia and elsewhere has been discussed and brought before the proper authorities.

(14) *Anhydrite.*—The possibility of utilizing anhydrite has been discussed and referred for consideration.

(15) *Barite.*—The possibility of finding a market for Canadian Barite has been similarly discussed and referred.

(16) *Galvanized Scrap Iron.*—Recommendations looking to the use of scrap galvanized iron and tin plate have been acted on by the Advisory Council.

(17) *Other Business.*—Many other matters of interest to the Mineral Industry have been considered and informally dealt with.

## APPENDIX C.

## REPORT OF THE BRITISH COLUMBIA HONORARY ADVISORY COMMITTEE OF THE RESEARCH COUNCIL.

(Reported by the Chairman, R. F. Hayward, M.E.I.C.)

At the present time there is no iron and steel making industry on the Pacific coast, but it appears to be the opinion of those in the iron and steel business that there is room for one plant, provided that that plant is assured of the whole of the Pacific coast market, including United States and British Columbia.

Before the United States entered into the war an investigation was being carried out by interests connected with the Utah Copper Company. In the year 1916 they had some large parties in the field making examinations of ore bodies and prospects. They also spent a large amount of money investigating the market and the best site for the establishment of blast furnaces and rolling mills. Such information as they secured is not available, but as far as I can learn they decided that a location in the neighbourhood of Seattle would be best for the establishment of a blast furnace. I understand that sufficient capital was at that time available for the enterprise at such time that they had determined that the market could be properly secured and that there were sufficient ore bodies to work upon. I presume that more will be heard of this enterprise now that the war is over.

In view of the possibility of the establishment of an iron and steel plant in the State of Washington, it is not likely that a similar plant could be established on a proper commercial basis in British Columbia, and there would not appear to be any reason why the Dominion Government should go into such an undertaking itself.

On the other hand, the establishment of a steel-making plant in the Puget Sound district would help the development of industries in British Columbia almost as much as a plant established on this side.

There is still a very large amount of development work to be done with respect to the ore bodies in British Columbia before any plant can be established on the Pacific coast. The report of Mr. W. M. Brewer, issued by the British Columbia Department of Mines in Bulletin No. 3-1917 states as much as is known of the ore bodies but the report shows that no large quantities of ore have been blocked out at any place.

Prof. Turnbull of our committee has undertaken to make a further compilation and report upon the iron ores.

During the war the Panama Canal, on account of the absence of tonnage, has had no effect on Pacific coast business but as soon as shipping is available it will have a profound effect on transportation costs. It will doubtless enable the manufacturers of pig iron to ship their product from the Eastern part of Canada, as well as from the United States to British Columbia at a very low rate, and until it is known to what extent this will reduce prices of pig iron and other steel on the Pacific coast it will be very unwise to enter upon any large iron and steel undertaking.

The iron and steel business in British Columbia must grow from small beginnings and gradually build up.

Small rolling mills have already been established to work up scrap and these will develop with the demand into larger affairs.

The steel and wooden ship building is making large demands for this kind of product and is also filling the boiler shops and machine shops with work of all kinds.

The ship building will, in course of time, drop off to an extent though we believe it will continue as a permanent thing, and the foundries and machine shops, which are now manufacturing winches and other machinery for ships, will gradually enter into the manufacture of logging machinery, mining and other machinery required for the development of British Columbia and the Pacific North West.

One five ton electric furnace is now producing pig iron from scrap, and a second will shortly be put in service for the same purpose. When the price of pig iron is reduced to normal these furnaces will have to turn to producing steel billets.

A two ton electric furnace for making steel castings and producing tool steel is also being erected.

From these beginnings we expect the iron and steel industry to gradually grow to larger things. We hope it may be possible to start an electric smelting furnace for the magnetite iron ores on a comparatively small scale in connection with other electro-chemical industries as suggested in my report, and if this can be done the iron and steel business will be started on the best possible basis.

The committee on the carbonization of wood waste has not been able to accomplish much as yet. This matter is of very great importance to British Columbia, and should be studied from every possible point of view. I think that any information, of a practical nature, that can be procured should be made available for the people in the lumber and logging industry.

## REPORT OF COMMITTEE ON IRON AND STEEL PRODUCTION OF THE BRITISH COLUMBIA HONORARY ADVISORY COMMITTEE OF THE RESEARCH COUNCIL.

Owing to the summer engagements of the members of the sub-committee appointed to report on the economical possibilities of producing iron and steel in British Columbia we have little progress to report.

The British Columbia Committee was requested to take up this question by Dr. Macallum in a letter under date of April 4.

In a letter dated April 17, in reply thereto, your chairman wrote as follows:—

"Investigation into the question of the economical production of iron and steel in British Columbia will probably divide itself into the following heads:

1. Location, quality, and development of the ore bodies, and the probable cost of mining.
2. The coking qualities of local coals.
3. The location, quality and cost of production of limestone and other fluxes.
4. The production and quality of fireclay, firebricks, silica and magnetite.
5. The relative cost of installing steel plants in Vancouver, as compared with other points on the Pacific Coast and Eastern Canada.
6. The cost of labour at the present time and the probable cost in the future.
7. The probable cost of the production of pig iron from blast furnace.
8. The probable cost of the production of pig iron from electric furnace.
9. The cost of power.
10. The market for pig iron on the Pacific Coast and for exportation.
11. The market for rolled section and plates.

At the meeting of the British Columbia Committee on May 16 the following subcommittee was appointed to consider this question:—

Dr. D. McIntosh,
Prof. J. M. Turnbull,
H. R. McMillan,
J. J. Warren,
R. H. Stewart,
R. F. Hayward.

On March 22 there was submitted to the Minister of Mines at Ottawa a memo from a delegation from British Columbia in which is set forth an argument for the establishment of an iron and steel industry in British Columbia. Copy of this is attached. While this memo sets forth clearly the benefits which would ensue if an iron and steel industry could be established in British Columbia, it brings forward no evidence to show that there has been any sufficient development of the ore bodies in British Columbia on which can be based data for the establishment of an iron and steel industry, or that there is any sufficient data of any kind upon which to base the formation of such an industry.

It is clear that a very great deal of expensive scientific investigation will have to be undertaken before any practical consideration can be given to the establishment of the iron and steel industry on a large scale.

The first thing to be done is to determine the extent and nature of the available ore bodies, and any aid that can be given either by the Provincial or the Dominion Government to this work will doubtless produce valuable results.

Such work, however, would take a long time even if a very large sum of money were immediately available, and in the meantime the iron and steel industry in British Columbia can only be expected to start from small beginnings and gradually to grow to larger things.

The most likely direction in which immediate progress can be made is in electric smelting.

There is at the present time only one electric furnace in British Columbia. This is a 5 ton, 3-phase, furnace established at the Port Moody Steel Works by the Aetna Iron and Steel Co., and now being operated by the Columbia Iron and Steel Co. This furnace has been in operation since the end of May. It is producing pig iron from ordinary scrap and the product is being exported to Japan at a price of about $70 per ton. So far the maximum production in any month has been 380 tons, but it is hoped that a steady production of 500 tons per month can be obtained.

The use of an electric steel furnace for such a purpose is clearly only justified by war prices, and high grade steel instead of cast iron will have to be produced after the war.

There is at present no electric steel casting furnace in British Columbia, and in this respect Vancouver is badly behind the times. There is only one steel foundry in Vancouver, and while this is doing good work its product cannot approach the product of the electric steel furnace for castings.

Negotiations are under way, if not concluded, for the establishment of a second electric furnace for the production of pig iron, using part scrap and part ore.

The existing power companies can sell power for melting steel in electric furnaces at a remunerative price which costs the producer about $6 per ton of product for the power used. The amount of power, however, which is required for smelting iron ore is three times as great as is required for melting, and the product for the "after the war" market could not possibly stand a price for power of $6 per ton. On the other hand the existing power supply companies, having been built for general light, power, and street railway purposes, cannot sell power remuneratively at the low price required for smelting iron ore under the conditions of electric smelting which have prevailed up to the present time.

If a high grade steel can be produced in one process directly from the ore, as is being done in the experimental furnace of Dr. Robert in Seattle, it is possible that the electric furnace could pay a price for power which would be remunerative to the existing power companies.

If a process can be made commercially successful whereby the preliminary reduction of the ores can be carried out by reducing gases at low temperature, and reduction can be furnished in the electric furnace, the amount of power required per ton of product will be so greatly reduced that the existing power companies will be able to sell power for electric smelting, on a small scale, at prices which would make smelting profitable. Furnaces of small capacity could then be established at various convenient points in British Columbia.

If, however, electric power amounting to around 2,000 kwh. per ton of product is required for smelting purposes then it would appear that some one of the numerous power sites on the British Columbia coast will eventually have to be developed for this special purpose.

There are a number of sites on Vancouver Island, and along the coast between Vancouver and Prince Rupert, where power can be developed as economically (considering differences in cost of material and labour), as any power development that has been made in Norway or Sweden. These power sites are situated at tide water where ore, limestone, coke and other raw matrials can be delivered at low cost, and the product can be shipped from the works in ocean going vessels at any time of the year.

Such power, however, cannot generally be economically developed unless the plant is built to the fullest possible capacity at the start. This usually involves an investment that is too large for any small commercial undertaking. If, however, there could be established a group of industries for the electric smelting of iron, ferro-manganese and other metal products, for the production of nitrates, calcium carbide and other electro-chemical products a sufficient demand for power would be created to make it possible to take full advantage of the economical value of the power sites along this coast.

It appears to be quite possible that such an undertaking might be commercially successful either under war, or after the war, conditions, and it is suggested that further investigations along these lines would be of value.

At the instance of the Provincial Minister of Mines, Dr. A. Stansfield, Professor of Metallurgy, McGill University, came to British Columbia in June to make an investigation of the whole subject, and when his report is published there is no doubt that much further light will be thrown upon the problem, and that your Committee will be able to see more clearly the direction in which it could make effective investigation.

## APPENDIX D.

## THE PETAWAWA FOREST SURVEY FOR 1918.

During the past year the Dominion Forestry Branch continued the detailed forest survey of the Petawawa Military Reservation, which was begun late in the season of 1917. The appropriation for the work was made by the Honorary Advisory Council for Scientific and Industrial Research at the request of the Dominion Forestry Branch of the Department of the Interior. We fully realize the great importance of studying the scientific principles of forestry to determine what may he applicable to Canadian conditions, and the permission granted to the Forestry Branch of the Department of the Interior by the Department of Militia and Defence to carry on silvical studies and silvicultural experiments on a portion of the Petawawa Military Reservation was greatly appreciated. Thus it will be seen that a system of co-operation between the Council, the Dominion Forestry Branch and the Department of Militia and Defence has been introduced by which the military reservation is made a Dominion Forest Experiment Station.

Before a comprehensive plan for the intensive management of the reservation and for the setting aside of experimental areas for the purpose of studying and demonstrating different systems of silviculture can be properly drawn up, full information in regard to the topography and the conditions of soil and forest cover must be secured.

The forest survey is gathering the necessary data through a systematic examination of the area. A map is being prepared showing topographical features, boundaries

of forest, and soil types and distribution of age classes. Careful descriptions are made of the various soil and forest types which are met with; the character of the ground cover is studied; the timber is estimated in cubic feet, cords or board feet; data are being collected for the preparation of volume and growth tables; damage by insects and fungi and from other causes is studied and described, etc.

In addition, a beginning has been made to study, through repeated observations on permanent sample plots which have been laid out, such important subjects as natural reproduction after fire and logging, the effect of thinnings of different methods and grades, and yield in fully stocked stands of various species and ages on different classes of site.

The report of the officer of the Forestry Branch who was in charge of the forest survey during the past season has now been received, and, while no decision concerning the future silvicultural management of the forest reserve can be arrived at before the survey has been completed and all data carefully compiled and considered, it may be of interest to readers of this report to have presented to them in brief how the Petawawa Military Reserve is described by the chief of the survey party.

The Petawawa Military Reservation covers an area of approximately 150 square miles. It is situated west of the Ottawa River and is bounded on the south by the Petawawa and Barron Rivers. The north boundary follows in the main the Chalk River Settlement and Corry Lake.

The whole of the tract has been lumbered over on various occasions. The southern section tributary to the Petawawa River was cut clean and mostly burned over some sixty years ago. The northern section tributary to Corry Lake was logged over 20 to 30 years ago. Practically all of the reserve has been burned over during the last 60 to 75 years. Due, therefore, to lumbering and fires, there is very little mature timber to be found. Except on areas which have recently been fire swept, however, forest cover has been established in a more or less satisfactory manner. The species reproducing are not always the most desirable ones, but the density is, as a rule, fairly good, if not entirely satisfactory.

*Topography.*—The elevation of the entire tract varies from 475 to 900 feet above sea level. The surface of the tract is rolling. All elevations are capable of good tree growth although on some ridges the soil is very scanty due to repeated fires. Most of the higher altitudes are covered by a fairly complete cover of red oak which does not reach merchantable size, but which preserves and improves the site very well. White pine reproduction appears to thrive under its shade.

There are numerous lakes in the area examined but with two or three exceptions they are all very small and of but little importance.

*Forest Cover.*—The forest cover is made up of a great number of species. Numerically, the most important are white pine, red pine, jack pine, white spruce, black spruce, balsam fir, aspen, white birch, yellow birch, red maple, sugar maple, beech, red oak, iron wood. Other species found are bass wood, mossy cup oak, black ash, white ash, white elm, hemlock, cedar, tamarack, silver maple, moose maple, large toothed aspen, mountain ash, black cherry, bird cherry.

These species form a number of types which are found more or less intermixed over practically the whole area. The forester in charge of the survey describes the following main forest types:—

1. *White and Red Pine Types.*—Stands of both red and white pine are found almost pure; as well as stands of the two species mixed in all proportions. Practically all stands of this type are less than sixty years old.

2. *Spruce and Balsam.*—Similarly to the manner in which white and red pine are found in all proportions, so spruce and balsam exist. Unfortunately, balsam is numerically superior.

3. *Tolerant Hardwoods.*—This type comprises those stands the composition of which is largely made up of such hardwoods as maple, basswood, iron wood, yellow birch and beech. These species are prolific seeders and tolerant. Especially is this true of the maple, and it is those qualities that render this type a menace to the reserve. For a great part of the reserve water is the only feasible transport. Consequently, the hardwood species cannot be readily marketed. The tolerance and seeding habits of these species render them difficult to eradicate. They very often reproduce beneath the more open stands on the best sites and gradually usurp the territory.

4. *Jack Pine Types.*—This type is found in the most sandy soils especially in the eastern and southern portions of the reserve. The jack pine is often found in mixture with red pine and sometimes with white pine or with both. Jack pine should be ranked only as a temporary type to be superseded by red pine at as early a date as possible under the plan of management adopted.

5. *Poplar and Birch Type.*—Just as in the case of red and white pine, and spruce and balsam, these two species mix so readily and change their percentage composition so gradually that it is quite impossible to map them separately. Their range of sites is greater than that of any other type, but on the good sites poplar is usually the more numerous, while on the poorer sites birch predominates. Poplar and birch are but temporary types and should be replaced by better species when they are removed. However, their crowns are thin enough to permit even white pine and red pine to seed in beneath if the site is adapted to them. Often a complete cover of spruce and balsam or even white and red pine was found as an undergrowth in this type. The area covered by this type is greater than that of any other.

The site classes are given as follows:—

> Site I. *Sand Loam Valley.*—Generally occupied by poplar and birch type. Potential white spruce site, but the spruce is very rare, probably due to fires.
>
> Site II. *Sand Loam Slopes and Low Hills.*—Generally occupied by birch and poplar with undergrowth of white and red pine or by nearly pure stands of white pine. Potentially this is a white pine site.
>
> Site III. *Sand Plain of Dune Sand.*—Jack pine is the dominant species but stands of red pine exist, which show remarkable growth and health.
>
> Site IV. *Ridges*—Stands of white pine. Red oak often takes possession of the soil after fires but white pine seeds beneath it and appears healthy. On the rockiest ridges jack pine is sometimes found in dense stands.
>
> Site V. *Muskegs and Swamps*—Some of the drier muskegs contained valuable stands of spruce or white pine which had been only lightly culled by the loggers.

*Underbrush and Ground Cover*—With but a very few exceptions the timbered stands have considerable underbrush and ground cover present. The exceptions are overcrowded stands or those of full density. On the drier locations where the stand is open, as for instance in the eastern portion of the reserve, the ground cover is composed principally of bracken, *(Pteris aquilina)*, sweet fern *(Myrica asplenifolia)*, blueberry, raspberry, strawberry, sheep laurel *(Kalmia angustifolia)*. On the somewhat better sites when the stand is open, hazel is found in mixture with bracken. When the stand is dense or fairly dense white pine or red pine, the ground cover is very sparse. The principal plants found, according to the report of the forester in charge of the sample plot work, are wintergreens *(Pyrola secunda, Pyrola elliptica, Pyrola americana, Moneses uniflora)*, Prince's pine *(Chimaphila umbellata)*, Checherberry *(Gaultheria procumbens)*, Bunch berry *(Cornus canadensis)*, *Maianthemum Canadense*, Partridge berry *(Mitchella repens)*, *Linea borealis*, *Waldsteinia fragarioides*, June berry *(Polygala paucifolia)*, and a few others.

In fresh or moist situations and hardwood stands are found hazel, striped maple, moose maple, arrow-wood *(Viburnum)*, leatherwood or moose wood *(Dirca palustria)*, Dogbane *(Apocynum)*, various ferns, violets, several species of the lily family, among others, Indian cucumber root *(Medeola virginiana)*, Solomon seal *(Polygonatum)*, *Maranthemum*, *Trientalis americana*, *Clintonia borealis*, several asters, Ginseng and many others.

When no crown cover exists on moist or wet soils, alders flourish in dense thickets from six to twelve feet in height.

***Biological and Physical Injuries.***—Since most of the stands are comparatively young and quite thrifty, they are to a large extent free from biological injuries. Each species, however, has its enemies present, although the attacks in most cases are very local. White pine is threatened when young by the white pine weevil (Pissodis strobi), especially in pure stands.

Balsam, although at present little affected, is menaced however, by a heart rot. Several cases of extreme infection were noticed but they were in trees approximately sixty years old which had suffered from suppression.

Poplar is also to some extent damaged by heart rot, but the cases are usually found on dry situations where the power of resistance is not very great.

Many attacks on young red pine by a sawfly *(Lophyrus pini)*, were noticed. No serious damage appears to have been done however.

The report of the examining forester also contains many tentative recommendations in regard to the silvicultural treatment of the various types and stands. The matter is not however, taken up for discussion by the Forestry Branch this year as it is considered advisable to first complete the survey so that the final report and maps will be available. Furthermore the study of growth and volume must be carried on for another season or two before sufficient data will be on hand on which to base future recommendations in regard to the silvicultural treatment of the individual forest types.

It is expected that the survey will be completed during the season of 1919.

## APPENDIX E.

## SPECIAL REPORT ON THE OPERATIONS OF THE LIGNITE UTILIZATION BOARD SINCE ITS INCEPTION, OCTOBER 1, 1918.

At the first meeting of the Research Council, held in Ottawa on December 4-6, 1916, a lignite committee was appointed, consisting of Mr. R. A. Ross (Chairman), and Drs. Adams, McKenzie and Murray. The urgency of the existing fuel situation prompted the Research Council to appoint this committee, and the passage of time has but served to emphasize the need for a successful solution of the lignite question among the other Canadian fuel problems. The situation confronting the committee at that time was briefly:—

Western Canada had been importing about 500,000 tons of anthracite from Pennsylvania, at a cost of approximately $5,000,000 per annum. This was in spite of the fact that underlying certain parts of Saskatchewan and Alberta there are immense deposits of lignite coal, which, owing to their peculiar characteristics, had not been scientifically developed. It was becoming increasingly evident that the anthracite supplies in the United States, apart altogether from the question of wartime demands, were rapidly reaching a point where their complete exhaustion was within view. Under such circumstances it would be folly for Canada to expect the United States to ship anthracite beyond its borders indefinitely, and any step to make Canada self-supplying in the matter of fuel would not only tend to satisfy national aspirations, but would also be a measure prompted by such elementary considerations as climate, exchange, balance of trade, shipping, etc. It had been repeatedly shown in laboratory tests that in spite of their peculiar characteristics, the Saskatchewan lignites were capable of being developed by carbonization and briquetting into a fuel that is a practical equivalent of anthracite. It remained, therefore, for the Research Council to present to the Government figures showing that this scheme contained more than a strong probability of commercial success.

After thoroughly threshing out the whole question, the Committee presented its report to the Research Council, and in June, 1917, the Council brought the matter to the attention of the Government.

The report showed clearly that, making no allowance whatever for the value of any by-products that might be recovered, carbonized briquettes could be produced at the plant for approximately $7 per ton. This figure included overhead charges, depreciation, etc., but did not include any profit. The ruling price for anthracite throughout this region was, in pre-war times, $10 to $15, and when it is remembered that these briquettes will be the approximate equivalent of anthracite in heating value, the saving to the consumer will be self-evident.

The report recommended that a plant having a capacity of 30,000 tons per annum be laid out and erected, with the proviso that for the trial period only one carbonizing oven be installed, thus reducing temporarily the capacity to 15,000 tons, and deferring the purchase of the second oven until commercial tests on the first had demonstrated its entire suitability.

The report further recommended that owing to the nature of the undertaking, the necessary capital should be supplied by the Government, but that the handling of the project should be entrusted to an independent commercial board.

As a result of the above-mentioned efforts of the Research Council, the Government, on the 20th of March, 1918, passed an Order in Council recommending that an agreement be prepared by the Minister of Mines which would unite the Dominion Government and the governments of the two provinces, Manitoba and Saskatchewan, in a joint lignite undertaking. This agreement was drawn up and signed on the 20th of July, 1918. By its terms, the three governments agreed to set aside the sum of $400,000—$200,000 from the Dominion and $100,000 each from the two provinces concerned. The carrying out of the undertaking was to be entrusted to a board of three members without salary, who would have complete charge of the whole project, this board to be known as the "Lignite Utilization Board." The agreement having been signed, the Government, by Order in Council of the 2nd of August, 1918, appointed Mr. R. A. Ross, of Montreal, as Chairman, and Mr. J. M. Leamy, of Winnipeg, and Mr. J. A. Sheppard, of Moosejaw, as the remaining members of the Board.

The first meeting of the Lignite Utilization Board took place in Montreal on September 16th, 1918. At this meeting a rough programme of operations was tentatively adopted. This programme comprised five distinct steps.

(i). A period of investigation into commercial practice on coal distillation, briquetting and other subjects related to the proposed lignite industry. These investigations would also include a thorough examination of each and every scheme or suggestion that had been brought to the attention of the Research Council during the two years preceding the appointment of the Board. Time estimate for this period, 6 to 8 months.

(ii). A designing period, during which the plant layouts will be made, machinery purchased and plant constructed. Time estimate for this period, 12 months.

(iii). A period of commercial adjustment in order to determine the best mixtures, heats, etc., necessary to produce a commercial product. Time estimate for this period, 6 months.

(iv). A commercial operating period, during which the product will be marketed through the ordinary channels of trade. Time estimate for this period, 6 months.

(v). The last duty of the Board will be to present a complete report giving full details of capital costs, operating and fixed charges, etc., etc.

The meeting of the Board was held on September 23rd, and at this meeting arrangements were made to acquire offices in Montreal, engage the technical staff and attend to all matters of business routine. On October 1st, the Board commenced its actual operations, the following staff having been appointed:

| | |
|---|---|
| R. DeL. French | Engineer |
| Edgar Stansfield | Chemical Engineer |
| Lesslie R. Thomson | Secretary |

On November 11th, Messrs. French and Stansfield left Montreal on their long tour of investigation, which was undertaken in conformity with the aims laid down in the investigatory period of the tentative programme. It had been hoped that as a result of their investigations, Messrs. French and Stansfield would be in a position to recommend the immediate purchase or design of each piece of apparatus required. But the Board's hopes in this matter were not realized, for though the briquetting difficulties had been practically solved, the knowledge and experience of the commercial carbonization of lignite were very meagre.

As a result of the situation outlined in the preceding paragraphs, and in order to avoid any waste of money on capital equipment ultimately proving valueless, the Board decided to instal in Ottawa a series of small commercial units; and to date, a press and mixer have been purchased and a special type of retort, new in principle, has been developed by Mr. Stansfield and is now partially completed. This experimental work is being carried on in a special shed erected by the Lignite Utilization Board in connection with the Fuel Testing Station, through the courtesy of the Mines Branch, Department of Mines.

The present situation may be epitomized in a word or two. The Board is determined not to spend one dollar on capital equipment until its experimental investigations in Ottawa demonstrate clearly the success of any proposed process or apparatus. To that end, it has initiated in its experimental plant in Ottawa investigations on the following matters:—

1. The weathering and storing qualities of lignite.
2. The heat of carbonization.
3. Rate of carbonization.
4. Atmosphere in retort during carbonization.
5. Special retort of new type developed by the Board.
6. Briquetting investigations covering:
    - (a) Material
    - (b) Degree of fineness
    - (c) Binders
    - (d) Mixers and presses.
7. Smokelessness.
8. Tests of finished briquettes.

In spite of long delays in delivery of certain apparatus, it is hoped that by August 1st results will have been obtained in a sufficient number of the above listed experiments to enable the Board to carry out its original programme of letting contracts and starting building operations before the winter of 1919-20. To date, the work is progressing satisfactorily, and results of great value have already been recorded.

In closing this summary, the undersigned wishes to record the Lignite Board's appreciation of the co-operation of the Mines Branch, Department of Mines.

(Signed) LESSLIE R. THOMSON,
*Secretary.*

Montreal, May 17th, 1919.

## APPENDIX F.

### GENERAL REGULATIONS

GOVERNING

### The award of Bursaries instituted by the Honorary Advisory Council for Scientific and Industrial Research.

1. These Bursaries are intended, not to facilitate attendance on ordinary collegiate studies, but to enable students, who have passed through a college curriculum and have given distinct evidence of general ability, and, especially, have won distinction in scientific study during their undergraduate course, to continue the prosecution of science with the view to aiding its advance or its application to the industries of the country. These Bursaries are open to men and women. Only ten will be awarded for the year 1919-20.

2. The Bursaries are each of the value of $500 for one year.

3. A student holding a Bursary who shows distinct evidence of capacity for original research may be given a studentship at the end of his tenure of the Bursary.

4. Application for a Bursary must be made by the candidate to the Advisory Council. He shall, with his application, submit a complete record of his academic career and recommendations from the president of his university or institution, the head of the department with which he was connected, and the chief scientific instructors under whom he studied, showing that in their estimation he promises to be worthy of training for scientific research. He shall state the institution at which he prefers to study and the general line of work to be followed. The application will be considered and decided upon by the Advisory Council or by a special committee appointed by the same.

5. The candidate must be a British subject, resident in Canada and a graduate in Arts or Science of a recognized Canadian University or college and must be between the ages of nineteen and thirty. He must have attained a high general academic standing, and especially in the scientific subjects of his undergraduate course.

6. The departments of science in which excellence in scientific study will be considered are: Biology, Chemistry, Physics, Mineralogy, Geology, Metallurgy, and Engineering.

7. Bursaries may be held at any Canadian university or institution approved by the Advisory Council.

8. The principal work of the holder of a Bursary must be a research in some branch of science.

9. Holders of Bursaries are required to devote themselves for a period of at least nine months of each year wholly to the objects of the Bursaries, and are forbidden to hold any position of emolument or to engage in teaching.

10. Holders of Bursaries are required to furnish to the Advisory Council reports of their work at the end of each half-year of the tenure of their Bursaries.

11. The Bursary stipend is payable in two equal instalments, on September 15th and February 1st.

## APPENDIX G.

### ASSISTED RESEARCHES.

| Name. | Subject of Research. | Amount. |
|---|---|---|
| Forestry Branch, Dept. of Interior | Petawawa Forest Survey | $6,214 57 |
| Prof. W. P. Thompson | Investigation on genetics of wheat | 4,500 00 |
| Prof. A. Stansfield | Investigation on reduction of iron ores by gases at low temperature and the electric furnace. | 2,500 00 |
| Prof. V. K. Krieble | Investigation on character and amount of sugars in sulphite liquor from pulp mills, with a view to utilization of these sugars in manufacture of industrial alcohol. | 200 00 |
| Prof. C. V. Christie | Determination of the dielectric constants and dielectric strength of materials to be used for insulation of high voltage cables and their variations with increased temperature and varied voltage, frequency and humidity. | 250 00 |
| Dr. J. B. Tingle | Preparation of acetic anhydrides and polynitro phenols | 1,200 00 |
| Dr. J. B. Porter | Flotation of Canadian ores by waste oils from wood distillation. | 1,500 00 |
| Prof. L. Bourgoin | Utilization of ultra-violet rays | 1,185 00 |
| Dr. L. V. King | Experiments on fog signalling apparatus | 500 00 |
| A. T. Stuart | Investigation on unit storage battery on laboratory scale of the oxy-hydrogen type. | 2.000 00 |
| Engineering Standards Association | Canadian Engineering Standards | 2,480 00 |
| Biological Board of Canada | Research on chemistry and bacteriology of fish curing | 7,000 00 |

## APPENDIX H.

### LIST OF STUDENTS AND FELLOWS.

#### FELLOWSHIPS.

| Name. | Where Held. | Subject of Research. |
|---|---|---|
| W. H. Hatcher | Chemistry Department McGill University. | Preparation of Pure Concentrated Solutions of Hydrogen Peroxide. |
| W. F. Seyer | Chemistry Department McGill University. | Properties and Composition of the Substances obtained from Tar Sands together with their commercial application. |
| O. J. Walker | Chemistry Department McGill University. | Study of Conditions that effect vulcanization of rubber. |

## APPENDIX H—*Concluded.*

### STUDENTSHIPS.

| Name. | Where Held. | Subject of Research. |
|---|---|---|
| D. G. MacGregor .......... | Chemistry Department. . . McGill University. | Separation of the Products of Distillation of Coal in the manufacture of coal gas with special reference to separating the phenols and allied substances from weak bases, such as pyridin, etc. |
| Miss M. Newton... ..... | Macdonald College, P.Q. ... | Resistance of various varieties of wheat to the form or forms of *Puccinia Graminis* found attacking wheat in the grain-growing regions of Canada. |
| Miss E. Shanly. ............ | Pathology Department. .... McGill University. | Growth at low temperatures of bacteria from frozen fish. |
| H. A. Braendle .......... | Physics Department ........ Toronto University. | Elasticity of non-isotropic samples of crude rubber along different directions and to determine the relation of this property to the swelling in different directions. |
| W. W. E. Ross.. . .. .... | Physics Department ....... Toronto University. | New method for determining the size of the change on a colloidal particle and the mass of the particle. |

## APPENDIX I.

### PUBLICATIONS OF ADVISORY RESEARCH COUNCIL.

#### REPORTS.

| Report No. | Title. | Author. |
|---|---|---|
| 1 | The Briquetting of Lignites .. ............. ..... | R. A. Ross, E.E. |
| 2 | The Recovery of Vapours from Gases . . . ..... | Harold S. Davis, M.A., Ph. D. and Mary Davidson Davis, B.A. |
| 3 | The De-tarring of Gas by Electrical Precipitation.. | J. G. Davidson, Ph. D. |
| 4 | Nicotine and Tobacco Waste........... .... .. | A. D. Hone, M.A. |
| 5 | Canadian Waste Sulphite Liquor as a Source of Alcohol. | Vernon K. Krieble, M.A. |
| 6 | An Investigation into the question of early Putrefaction of Eviscerated Fish in which the Gills have been left. | Louis Gross, M.D. |

#### BULLETINS.

| Bulletin No. | Title. | Author. |
|---|---|---|
| 1 | The Need for Industrial Research in Canada...... | Frank D. Adams, Sc. D., LL.D., F.R.S. |
| 2 | Researches on Sound Measurement ............ | Louis V. King, M.A.D. Sc., |
| 3 | How to Handle Frozen Fish.... ................ | E. E. Prince, D. Sc., LL.D. |
| 4 | Hints on Frozen Fish ............... ......... | E. E. Prince, D. Sc., LL.D. |
| 5 | Science and Industry.... ...... . . ...... .... | Prof. J. C. Fields, Ph. D., F R.S. |
| 6 | The Heating of Houses, Coal and Electricity compared. | A. S. L. Barnes. |

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## APPENDIX J.

## CENTRAL INSTITUTE FOR RESEARCH FOR CANADA.

*The Recommendation thereon from the Honorary Advisory Council for Scientific and Industrial Research.*

The Honorary Advisory Council for Scientific and Industrial Research has for the last year and a half given careful consideration to the question of founding a Central Institute for Research which would serve as a laboratory for standards and also for investigations of Canadian raw material, industrial processes and manufactured products and thereby greatly aid in the development of Canadian industry and the effective utilization of the natural wealth of the Dominion.

The fact that a number of governments, British and foreign, have founded organizations with similar or approximately similar functions is indicative of their importance as factors in the development of national industry. The Bureau of Standards at Washington, for which Congress annually votes large appropriations, besides serving as a national laboratory for standards of all sorts, physical, electrical, metallurgical and chemical, undertakes research in conjunction with the industries, the development of which it strives to assist by experimental investigations of their raw materials, their processes of manufacture and their products. The National Physical Laboratory at Teddington, near London, which now has an annual budget of over £150,000, nearly parallels the Bureau of Standards and functions also as a laboratory for research for the industries in mechanical, physical, electrical and metallurgical lines. The Royal Physical Technical Institution (Physikalish-Technische Reichs-Anstalt) at Charlottenburg, the Bureau of Standards for Germany, amply supported by the German Government, was of immense service to German industry before the war. A Chemical Institute (Chemische Reichs-Anstalt) at Dahlem, also supported by the same government, concerned itself, amongst other lines of chemical investigation, with researches on the raw materials and processes of German chemical industries.

The foundation of like organizations is proposed by other governments. A fund of $2,600,000 (5,200,000 yen), of which $1,000,000 has been voted by the Japanese Parliament, $500,000 granted by the Emperor, and the remainder given by private parties and institutions, has been obtained for the establishment, at Tokio, of a National Laboratory for Scientific and Industrial Research, which will have all the functions, on the one hand, of the Bureau of Standards at Washington, and, on the other, of an industrial research institute like the Mellon Institute at Pittsburgh, Pa. The French Government has now under consideration a report of the Academy of Sciences recommending the foundation of a National Research Laboratory for France. The Australian Advisory Council of Science and Industry has recommended to the Commonwealth Government the establishment of an institute for science and industry, in which will be comprehended national laboratories "for special purposes of research and experimental inquiry, including a physical laboratory for testing and standardizing purposes," with which the present government laboratories should be co-ordinated.

There is now under consideration a proposal to establish, in the Imperial College of Science and Technology at Kensington, a research department which will concern itself with fuels, wood and coal, distillation products, refractories, ceramics, chemicals and animal and vegetable products.

The existence of a very large number—more than two thousand is one estimate—of research laboratories in connection with large industrial concerns in the United States is also indicative of the importance there conceded to organized research in industrial development. There are more than fifty individual firms in the Union each of which annually expends sums ranging from $25,000 to $500,000 for research. The number of research laboratories in connection with the industries in Canada, adequately maintained, is almost negligible, due in large part to the smaller amount of capital employed in the great majority of the Canadian firms.

The interests of Canadian industries, in view of the keen competition from abroad to which they are, and will be, exposed, render imperative the application of the most advanced technical and scientific knowledge derived from research to their own problems of raw material and industrial processes. Their competitors abroad are employing, and will employ, for this purpose all the resources that research can or will furnish. They cannot, therefore, in order to succeed, do less than their rivals. To be wholly effective in this way they must combine, as the British industries, under the auspices of the British Research Council are now doing, to form trade associations or guilds for research, to which the Government should extend aid. The British trade associations for research are, in the great majority of cases, assisted by direct grants from the Imperial Department of Scientific and Industrial Research. The Research Council believes that the assistance which the Government could most wisely give such guilds should be in the form of free accommodation in laboratories of a central research institute, for their research staffs, for the salaries of which they will themselves be responsible.

The formation of guilds in the leading Canadian industries practically depends on the establishment of such an institute, as otherwise they could not find the funds to provide their own laboratories, since all their resources pooled for research would be sufficient only for the staffs for research which they would engage.

*The Council accordingly strongly urges the establishment of a Central Research Institute with the functions of a Bureau of Standards, and with such ample accommodation and equipment for research as the various guilds for research, which may be formed in the Canadian industries, may require.*

The Council is of the opinion that the building which would accommodate the institute should be constructed to meet immediate needs and yet be planned so as to admit additions or alterations of the basis of its construction or management, such as the future may render imperative. The immediate needs concern all the standards of measurement and materials used in the industries, and also the industries themselves in the various lines of which guilds for research are being promoted, which would require the accommodation the building proposed would provide for them.

The Building which the Council recommends is one of the Laboratory type, of four stories in addition to basement, and of dimensions 200 x 60 x 70 feet, in which, besides corridors and office and administration quarters, there would be at least 50 laboratory rooms of 25 x 25 feet dimensions. This would suffice for immediate needs and would serve for a number of years. In order to provide room for expansion and also additional laboratories which may be required in experimental work carried on on a semi-commercial scale, it should be located on a site fifty acres in area, at or near Ottawa, preferably in the immediate neighbourhood of the Experimental Farm, where city water supply and electric power are available.

The building should be of solid (or steel) construction and with cement floors. The cost of construction, it is estimated, would be $500,000. This would include the heating plant and the power equipment, as well as the ventilating and the water, gas and draining plumbing.

The cost of the scientific equipment of such a building would be approximately $100,000. This sum would be needed to provide the scientific instruments required in the various lines of investigation which would be undertaken.

The salaries would be about $100,000 per annum, but only a small part of this would be needed during the first year. The Director of the Institute should be appointed before construction begins, in order that the plans of construction may be carefully supervised and adapted to the work which the Institute may be called upon to do.

The Governing body of the Institute should be the Research Council, which, subject to the approval of the Sub-Committee of the Privy Council for Scientific and Industrial Research, would make all appointments to the staff and determine the salaries of the same.

In order to make this control complete and provide for the most thorough-going efficiency of the Scientific Staff of this institution, a slight amendment of the Act of Parliament creating the Honorary Advisory Council for Scientific and Industrial Research may be necessary.

## APPENDIX K.

## DRAFT OF PROPOSED RESEARCH INSTITUTE ACT.

1. This Act may be cited as the "Research Institute Act."

2. There shall be established at or in the vicinity of Ottawa a National Research Institute, hereinafter called the "Institute."

(1) This Institute shall have charge of:

(*a*) the investigation and determination of standards and methods of measurements, including length, volume, weight, mass, capacity, time and heat, light, electricity, magnetism and other forms of energy; and the determination of physical constants and the fundamental properties of matter.

(*b*) the standardization of the scientific and technical apparatus and instruments for Government service and for use in the industries of Canada and of the materials used in the construction of public works.

(*c*) the investigation and standardization of the materials which are or may be used in the industries, and of the products of the industries.

(*d*) researches undertaken with the object of improving the technical processes and methods used in the industries and of discovering new processes and methods which may promote the expansion of the existing industries or the development of new Canadian industries.

(*e*) researches undertaken to promote the utilization of the natural resources of Canada.

(2) The Institute shall have charge, direction or supervision of the researches which may be undertaken by or for single industrial firms under conditions to be determined in each case or by such organizations, to be known as Trade Guilds for Research, which may be formed in the various industries with the view improving the processes of production or the products of these industries, as may desire to avail themselves of the facilities offered for this purpose by the Institute.

3. The technical staff of the Institute shall consist of a Director and such scientific and technical officers as may be necessary for carrying on the work of the Institute. They shall be appointed by the Honorary Advisory Council for Scientific and Industrial Research, hereinafter called the Research Council, and shall hold office on such terms and with such salaries as the Research Council may define or establish, subject to the approval of the Sub-Committee of the Privy Council for Scientific and Industrial Research, hereinafter called the Sub-Committee.

4. The control and direction of the work of the Institute shall be exercised by the Research Council through the Director, or, in case of illness, suspension or absence of the Director, or in case of a vacancy in the office of Director, through an acting Director temporarily appointed by the Research Council.

5. The Director shall devote the whole of his time to his duties as Director of the Institute in its various departments, and shall report to the Research Council on the work of the Institute from time to time or when called upon to do so. He shall have

the right to be present, as assessor, and without the right to vote, at all meetings of the Research Council while matters affecting the work of the Institute may be under consideration.

6. The Research Council may suspend the Director or any officer of the Institute from his office for incapacity, incompetency or misbehaviour, and, after full inquiry and for cause, may dismiss such suspended Director or officer, subject to the approval of the Sub-Committee.

7. The money annually appropriated by Parliament for the work of the Institute, or which the Council may receive through bequest, donation or otherwise, shall be expended under the direction of the Research Council, subject to the approval of the Sub-Committee, for the carrying on of the work of the Institute.

8. The Research Council, established under Chap. 20, 7-8 George V, is hereby constituted a body corporate, capable of suing and being sued, of holding lands, tenements, hereditaments, goods, scientific apparatus, chattels and any other property for the purpose of and subject to this Act. It shall have power to acquire by gift, grant, bequest or otherwise, any such property or money, or securities, for the purpose of this Act and subject to the approval of the Sub-Committee, to agree to any conditions of such gifts, grants or bequests.

9. All discoveries, inventions and improvements in processes, apparatus or machines, made by the members of the Scientific and Technical Staff of the Institute shall be vested in the Research Council and be made available under such conditions and payment of fees or royalties or otherwise as the Research Council may determine, subject to the approval of the Sub-Committee. The Research Council, with the approval of the Sub-Committee, may pay to scientific and technical officers of the Research Institute and to others working under its auspices, who have made valuable discoveries, inventions or improvements in processes, apparatus and machines, such bonuses as, in its opinion, the commercial or industrial value of such discoveries, inventions or improvements may warrant.

10. When for the sake of efficiency or economy, or for the purpose of preventing overlapping of effort in the scientific work of the various departments of the Government, or in the scientific work of the various commissions and boards constituted by the Government, it may be found desirable to provide that such scientific work shall be carried on in the Institute under conditions to be approved of by the Research Council, appropriate action thereto in each case may be taken by the Research Council when directed and empowered to do so by Order in Council.

11. There shall be a committee, to be called the Advisory Committee, to consist of not more than fifteen members, constituted as follows: One representative each of the Canadian Mining Institute, the Engineering Institute of Canada, the Canadian section of the Society of Chemical Industry, the Royal Society of Canada, the Royal Canadian Institute, the Manufacturers' Association, organized labour, and such organizations as may be recognized for this purpose by the Sub-Committee and three representatives of the Canadian Universities' Conference. This Advisory Committee shall meet at least annually to consider the work done by the Institute and report thereon to the Research Council and the Sub-Committee such recommendations regarding the work, or the organization, or both, of the Institute as it may deem advisable.

12. All the receipts and expenditure on behalf of the Institute shall be subject to examination and audit by the Auditor General and the Administrative Chairman shall submit a statement of such receipt and expenditure to the Sub-Committee at such times and containing such details as the Sub-Committee may prescribe. A detailed statement of all such receipts and expenditure during each fiscal year shall be laid before both Houses of Parliament within fifteen days from its opening.

13. A report of the work done by the Institute, containing such information and details as the Research Council and the Sub-Committee may require, shall be made by the Director to the Research Council and through the Research Council to the Sub-Committee after the close of each fiscal year, and the said report shall be printed and laid before both Houses of Parliament.

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## APPENDIX L.

## MEMORANDUM FROM THE FORESTRY BRANCH OF THE DEPARTMENT OF THE INTERIOR.

One of the difficulties in handling research work in the Government service is that men who make a success of research work are likely to be offered positions by commercial firms at salaries which are much higher than the Government will at any time be likely to offer. It therefore makes the holding together of a staff for research work rather difficult. On the other hand, if research work is to be carried out successfully it is almost absolutely necessary that the staff should be fairly permanent and should be composed of men who are really keen enough to make thorough investigations and discover new inventions and processes. Most men on the staff of the universities who are doing research work have opportunities for undertaking investigations for commercial firms for which they receive large fees outside of any salary paid them by the university, but the general departmental rules do not permit of Government officials employed in research work following a similar course.

This question has been discussed from time to time at meetings of the Advisory Committee of the Forest Products Laboratories of this department, which, as you know, consists of representatives appointed by this branch and others appointed by McGill University on the approval of the Minister, and it has been concluded that one way of assisting to meet the difficulty would be to make a definite arrangement about the handling of patents for inventions covering discoveries made by the staff of the Forest Products Laboratories.

If any member of the Staff during his research work makes any discovery it is felt, that, consistent with the proper protection of the public interest, he should be permitted to retain some of the benefits of the results of the discovery. On the other hand, many discoveries which would be valuable are not made use of simply because they are not placed before the public insistently enough. Manufacturers may not see the immediate value of them or they may involve changes in equipment that the manufacturers may consider would be so costly that the use of the invention would not make adequate return for the expenditure. Such investigations have at times been adopted by foreign countries and the country where the invention was made has sometimes waked up later to find that it was left entirely behind.

On a consideration of the whole case the Advisory Committee have approved and passed a memorandum a copy of which is submitted herewith, suggesting a method of dealing with the whole matter. It will be seen that it is suggested that the matter should be taken up by the Minister if it is to be taken up in connection with the Forest Products Laboratories only, but if the question is to be considered in a general way in relation to government Departments, it would seem opportune that the matter should be submitted to the committee on technical research which has recently been organized.

I feel satisfied personally that some such arrangement as that proposed is necessary in order to keep up a proper interest in the staff engaged in research work and to ensure a degree of permanency.

OTTAWA, December 21, 1916.

Respectfully submitted,
(Sgd.) R. H. CAMPBELL.

## MEMORANDUM RE PATENTS AND INVENTIONS OF CANADIAN GOVERNMENT EMPLOYEES ENGAGED IN RESEARCH.

1. It is desirable that government employees engaged in industrial and scientific research should be given as much incentive as possible to produce new ideas and

inventions of industrial value. This incentive could be supplied to a very large extent by assuring them of a fair share in the financial returns of any patent which they may bring forth.

2. It is also desirable that such patents should be developed to the point where their value is demonstrated and not remain unused for lack of such demonstration.

3. In all research work opportunities arise from time to time for inventions and improvements in various arts more or less directly connected with the investigations under way. These inventions may be either directly due to research, that is, practically speaking, they may be considered as being one of the objects for which the research was undertaken, or else they may be incidental to the research, being the idea of some one connected with the investigation, though the idea itself is not one which could be considered as being a direct outcome of the research in question. For instance, if a research were being conducted for the purpose of finding means of utilizing a waste product such as the bark from pulpwood and an invention was conceived which did find some new and profitable scheme for utilizing such material then such invention might be considered as being directly due to that research. But if in the same research, one of the investigators should conceive of an invention of a new form of apparatus for measuring the material, then that invention might be considered as one which was merely incidental to the research.

4. It would greatly stimulate the interest of those engaged in government research work and make for greater efficiency if these workers were allowed to participate in the results of any discoveries they might make. It is a great drawback to scientific work of government laboratories that salaries are almost entirely fixed within limits so that there is very little incentive for a man to put forth his best efforts.

Since it would not be fair to the public to allow employees engaged in research supported by the Government funds to appropriate to their sole personal use the results of the work for which they are paid, there should be some ruling whereby the respective rights of the public and the inventor will be judged and their proportionate share in the value of the invention decided. At the present time there is no such ruling in any Canadian Department which will serve as a guide and there is accordingly a disinclination among the men in government service to consider applying for a patent lest they encounter arbitrary rulings and difficulties over their rights.

5. Practically all inventions require the expenditure of money, sometimes in considerable amount, before returns are realized. To warrant the expenditure for the development of a new idea, there must be some protection so that there will be assurance that the invention so developed will be the property of those who invest in it. This consideration is sufficient in a great many cases to completely nullify the value of inventions which are made free to the public; no one is willing to invest the money necessary to develop them commercially and run the risk of losing his investment unless he is assured that in case the enterprise becomes successful he will be the one to reap the benefit. The United States Department of Agriculture has a rule that requires any employee of the department to patent any invention which he may conceive and assign the patent to the Department to be thrown open to the public. In consequence of this, employees of that department are liable to conceal their inventions until they leave the government service or else the patent, if taken out, is made of no value since no one can develop the idea with reasonable security. In the first case the service loses a good man as is shown by the fact that he had the ability to conceive the idea; in the second case the idea remains undeveloped and its value is almost entirely destroyed. Other Departments in the United States are more liberal —some having no ruling at all while others require only that if the Government wishes to use the patent it may do so without the payment of any royalty or commission whatsoever.

6. From these considerations it is suggested that patents and inventions of those government employees engaged in research or scientific work be dealt with in accordance with the following rules:—

(*a*) That a Committee be appointed to consider each individual case on its merits. This might consist, in the case of the Forest Products Laboratories, of a committee appointed by the Minister of the Interior or, in case the same rule is applied to all Departments, the committee might consist of a subsection from the Committee of Council for Research as designated in Order in Council of June 6, 1916, or be appointed by that committee.

(*b*) That government employees engaged on research or scientific investigations be granted patents without the payment of fees.

(*c*) That all such patents be assigned entirely to the committee aforementioned who will have full power to deal with the use of all such patents, as they see fit, being guided in their decision by the conditions of each individual case.

(*d*) That this committee have the power to sell or otherwise dispose of the rights of any such patent and that such portion of the proceeds as rightfully belong to the public be devoted to the furtherance of research and scientific work.

(*e*) That this committee be given authority to develop at public expense such inventions when the ownership of the rights belongs in part to the public.

7. The board of referees should have full power to deal with any invention as they see fit, but in general, it should be dealt with in one of the following ways:—

(*a*) Be thrown open to the use of the public without fee or restriction. This should be done where the invention is the direct result of research and where the invention is one of such a nature that it could be manufactured or the process made use of by any one without the necessity of being dependent on any development expenditure.

(*b*) Be sold or used under license and the proceeds divided between the inventor and the public in proportion to the part of the idea which may be considered due to the inventor as against that part which may be considered as the outcome of work for which public funds have been employed.

(*c*) Be returned to the inventor to be dealt with as he may desire. This should be done when the idea is solely due to the inventor and not to discoveries made during the course of his regular work which is paid for by the public funds.

8. Under this plan the employee would be assured that he would receive remuneration for his idea in proportion to what part of it was really his own; he would know that his invention would not die for lack of proper development on a practical scale and he would know that its value would not be lost by the patent being left open to everybody and so being avoided by all.

The committee by being able to spend the money necessary to demonstrate the value of the invention would provide the very necessary facilities for carrying it from the patent stage to the commercial stage and so protect it through the period in which many valuable inventions are lost. It would be impossible for the inventor to do this himself without leaving the Government employ to secure the necessary capital.

## APPENDIX M.

### SECTION OF THE DRAFT OF THE AMENDMENT TO THE PATENT ACT, ON THE GRANTING OF PATENTS TO TECHNICAL EMPLOYEES IN THE GOVERNMENT SERVICE, PREPARED BY MR. G. F. O'HALLORAN, COMMISSIONER OF PATENTS.

Every patent granted in respect of an invention made by a person while employed in the public service of Canada and relating to the nature of his employment shall, notwithstanding anything in the patent or the Patent Act to the contrary contained, be subject to the following conditions which shall be indorsed on such patent, that is to say:

> (*a*) The Commissioner may grant to any person applying therefor a license to use the patented invention on terms to be fixed by the Commissioner.
>
> (*b*) In fixing said terms the Commissioner shall have regard to the circumstances under which the invention was made and the right and interest of the Government of Canada therein in consequence thereof, which right and interest said government is hereby declared to have, and shall reduce the royalty payable to the patentee accordingly or apportion the royalty between the patentee and the Government of Canada, but in no case shall the amount payable to the patentee be less than one-half of what it would have been had the inventor not been in the public service when making the invention.
>
> (*c*) The patentee shall not make use of nor allow others to make use of the patented invention without the consent of the Commissioner, who in granting such consent may exact royalty for such use to be fixed by him and paid to the Government of Canada.
>
> (*d*) The Government of Canada shall have the right of action in any court of competent jurisdiction to restrain the unauthorized use of the patented invention and recover damages therefor, which may be apportioned by the Commissioner between the patentee and the Government in such way as to him seems fit.

(2) Any question which may arise as to whether any invention comes within the terms of this section shall be determined by the Commissioner on application for a patent therefor.

(3) On the refusal of such inventor to apply for a patent for such invention after being thereunto duly required by the deputy head of the department in which he was at the time of making the invention employed, such deputy head may in his said quality apply for and obtain a patent for such invention.

(4) Nothing herein contained shall be construed to restrict the right of the inventor to the full enjoyment of his invention outside of Canada.

## APPENDIX N.

## A BILL TO AMEND THE AMERICAN PATENT LAWS.

Authorizing the Federal Trade Commission to accept and administer for the benefit of the public and the encouragement of industry, inventions, patents, and patent rights, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

1. That the Federal Trade Commission be and hereby is authorized and empowered to accept assignment of, or license under; to develop; to issue or refuse to issue licenses under; to encourage the industrial use and application of, and otherwise to administer, on behalf of the United States, under such regulations and in such manner as the president shall prescribe, inventions, patents and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by employees of the various departments or other establishments of the Government, or by other individuals or agencies; and to co-operate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out.

2. That the Federal Trade Commission be and is hereby authorized and empowered to collect fees and royalties for licensing said inventions, patents and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited, a certain percentum, to be determined by the President, shall be reserved, set aside and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents and patent rights contemplated by this Act as may prove meritorious and of public benefit.

## APPENDIX O.

## REPORT IN CONNECTION WITH FISH WASTE INVESTIGATION ON THE ATLANTIC COAST.

By J. B. Feilding, *Fisheries Engineer.*

On receiving instructions, I left home for Ottawa on the 24th of April, and on arrival awaited on Dr. Macallum to receive his instructions. Leaving Ottawa on the 27th, I proceeded to Montreal en route for Nova Scotia.

I arrived at Halifax on the night of the 29th, and on the following morning called on Dr. Mackenzie at Dalhousie University and had some discussion on fishery questions generally relative to the Nova Scotia coast. I called on several of the leading fish buyers, but in every case found them out of town.

On the 1st inst. I left for Digby, thinking, after careful consideration, that I had better tour the southern part of the province first. At Digby I picked up some useful information, which resulted in my proceeding down Digby Neck through Centreville, Tiverton to Westport. From here I took steamer to Yarmouth and from this point I worked my way back to Halifax. From Halifax I went direct to Canso via Mulgrave, where I had the pleasure of meeting Mr. Edward Whitman, who has taken so much interest in this question.

From thence I proceeded to Bathurst, N.B., with a view to visiting Caraquet, but failed to get there owing to there being a temporary stoppage in the train service. I therefore proceeded to Campbellton and from thence to Grand River, in the province of Quebec. Here I met Mr. Walsh, district purchasing agent for the Gorton Pew Fish Co., of Gloucester, Mass. From thence I went to Gaspe in order to ascertain how far the fishing industry extended in the direction. From Gaspe I returned to Montreal, arriving on the 21st inst. My trip lasted in all double the time that was originally estimated.

The object of my tour, as I understood it, was to ascertain the quantity and availability of fish waste in economic tonnage and waste or unmarketable fish resulting from the fishing industry. My tour was, of necessity, somewhat curtailed owing to the time at my disposal. Therefore the conclusions I have come to must be accepted as only tentative.

Further, it was understood that I was to consider this problem from the aspect of its conversion to live stock feed, fertilizers, and oils.

I will now deal with the conditions as I found them, over this area, but before doing so I would like to call your attention to the factors that had to be considered.

No. 1.—The number of shore boats, sail and power, in a defined area in relation to their potential value in the scheme under consideration.

No. 2.—The class of trade pursued whether the fresh or dried fish business.

No. 3.—The possible quantity of non-edible fish that might be expected and the average proportion of it to the catch of other fish.

No. 4.—The price at which fishermen would bring fish waste and non-edible fish into port.

No. 5.—The availability of kelp of suitable type in the vicinity that might be utilized in the compounding of fertilizers.

No. 6.—The grouping of fishing villages within such distance that fish waste could be brought to a reduction plant at some central point in a fresh state.

No. 7.—The existing supply of fish waste and oil in such districts that I shall afterwards describe.

I found in this southwest section of the Province of Nova Scotia no individual port that could economically operate a plant as a business proposition, and, therefore, I considered the question of grouping ports within easy distance.

The first district considered and investigated was that lying along the Bay of Fundy between Parker's Cove and Gulliver Hole. Here I found as I did all through this southern district, a large number of boats engaged in the lobster industry, and these I was unable to classify apart from those employed in fishing proper. Between the ports above referred to I found in operation about 297 gasoline boats and 122 sail boats. I also found that the approximate waste on the average catch was about 4,500 tons, while the oil apparently collected in the district, was only extracted from the livers and not from the intestines. The value of the waste irrespective of the oil were it converted into protein concentrate would amount to $97,000 at current market prices. The natural point from which to radiate for the collection of this waste is Victoria Beach, and extends a distance of 10 miles in a southwesterly direction and 14 miles in a northeasterly direction. One 30-ton collecting boat could handle all the waste from this area.

Here as elsewhere I found the fishermen would be prepared to barrel the waste and would expect 20 cents a barrel weighing 200 pounds. Non-edible fish such as skate and dog fish, they would be prepared to bring in at prices ranging from seven to nine dollars a ton.

The next coastal section considered was that lying along the Bay of Fundy between Centreville and Westport, including a small section on the west side of St. Marys Bay, lying between Weymouth and Comeauville. This is an area given over largely to line trawl and hand lining with shore boats which number in all 421 gasoline and 210 sail boats or thereabouts.

I estimate the value of the oil and waste available if treated to amount to $123,000 per annum.

The next district considered was one radiating from the port of Yarmouth extending between Cape St. Mary and Tusket Island. In this area I found there were about 406 motor boats and 68 sail boats operating inshore on the lobster trade and hand line fisheries. The value of the waste and oil were it collected and treated in this district I estimate at $128,000 per annum. The fishermen would handle the material required by a reduction plant on approximately the same terms as before mentioned.

Between this section and the village port of Pubnico the fishermen are largely engaged in the lobster trade, and when that is over they appear to ship on the bankers out of Lockport and Lunenburg.

The next section visited was a district centred on Cape Sable island or more particularly Clark's Harbour. I found in this area that there were between six and seven hundred gasoline boats and from fifty to sixty sail boats employed in mixed fishing. The waste at present existing would, if treated, be worth approximately $104,000 per annum irrespective of the oil.

There are large and valuable kelp beds throughout this district which could be economically worked. Fishermen, I was given to understand, would be prepared to bring in this kelp at prices varying from $1 to $2 per ton. They would further be prepared to bring in non-marketable fish at from $6 to $7 per ton, and fish waste at around $4 a ton.

At Clark's Harbour I inspected the Government dog fish reduction plant which though very badly cared for appeared to be in working order, and well worth in my opinion retaining for the purpose of the manufacture of fertilizer, though quite unsuitable for the manufacture of food. The plant is very wasteful in operation since I was told by the manager that he would only get one ton of fertilizer from 10 tons of raw material. There are several improvements that could be easily made to reduce this waste, and save labour, and when set in order it certainly should not take more than from 5 to 6 tons of fish waste to make one ton of fertilizer concentrate. This even is not as good a return as an intermittent plant with vacuum drying could accomplish. It is indeed a fault associate with almost all continuous process machines.

From this district in a northeasterly direction the fishing industry is entirely in the hands of the banker, though lobster catching is carried on to a small extent in the coves all along the coast, as far north as Canso.

I proceeded, therefore, direct to Canso; here I found the centre of the greatest fishery on our Atlantic coast by virtue of its close proximity to the Banks. After spending several days here and inspecting the Government late dog fish reduction works and the Robinson glue plant, I came to the conclusion that an area defined as follows would be an economic waste collecting area centreing on Canso: the port of l'Ardoise, in Richmond county, Cape Breton, and Tor Bay, in the county of Guysboro.

The waste now available amounts to approximately 12,900 tons and the oil to 80,000 gallons. Were the former manufactured it would, together with the oil, at current market prices, be worth approximately $424,000 a year.

I ascertained that of the total fish caught in this district by otter trawl 30 per cent was constituted of non-marketable fish, while with the line trawl from 12 to 15 per cent appeared to be the rule. Fishermen would be prepared to bring in their waste fish at from $6 to $7 a ton, while their fish waste could be readily acquired at from $2 to $3 a ton.

After visiting this area I tried to reach Caraquet, but as I said before, was unable to get there. So I proceeded to Grand River, in the province of Quebec. Here, with the able assistance of Mr. Walsh, district agent for the Gorton Pew Co., I was enabled to visit and collect much valuable data at the points on either side, as well as at Grand River. The district centred on Grand River appears to be bounded by the ports of Ance au Beaufils and Paspebiac, extending along a coast line of about 70 miles. This appears to be a thinly populated district with a very rising fishery. The season is a short one and the fishermen are poor, and anything done to help them would be of the greatest benefit. They apparently fish from the 1st of June to the 1st of November—five months in all.

Here I found the worst and most extravagant waste; hundreds, if not thousands, of tons of herring and "ground" fish are gilled and spread out on the land with an intention of fertilizing it. Needless to say, the herring would be much better left in the water if not required for human food, for at least they would provide food for fish of more economic value. In Grand River alone it is estimated from 250 to 300 tons of herring alone are used annually in this way. The fish waste within this area I compute, irrespective of non-marketable fish, to be 7,000 tons, valued, when convertible, at $200,000 a year.

The Bay of Chaleurs appears to be the greatest haunt of ground fish, which could be used to great advantage in the manufacture of edible meals. Fishermen would be only too glad were they offered from $3 to $4 a ton for them, and would be prepared to hand over packed in barrels fish waste at from $1 to $2 a ton.

The number of boats operating in this area must be at least from 800 to 1,000—in the village of Grand River alone there are over 100 well-fitted power boats capable of fishing on the banks 8 to 12 miles out.

On all hands I found a great desire for help in the direction of giving the fishermen more occupation and using up the enormous quantity of available non-edible fish. I should say that by non-edible I include, of course, such fish as are at present unmarketable, though edible.

East and west of this area I found the fishing not sufficiently developed to justify the time and expenses that would be incurred in making investigation.

This terminates a somewhat rough and very cursory survey so far as I was able to carry it out in the time allowed.

There are, however, two important areas to be yet considered, viz., Caraquet and Grand Manan, both in the province of New Brunswick, and from what I have heard are well worth a careful inspection.

It will be noted that I have only lightly touched on the enormity of the available supply of non-marketable fish in certain areas of our Atlantic coast, which could be put to the extreme value much to the benefit of the farmer and the fisherman, and, further, would tend to give winter employment in many of the coast villages where a manufacturing industry would be a God-send. It may fairly and conservatively be stated that 15 per cent of the fishermen's catch consists of fish at present not marketed, and when it comes to the steam trawler this type of product is more often 30 per cent and as high as 50 per cent of the total catch. Much of this fish could be obtained at little cost with a small otter trawl on the mud banks inshore, were the fishing regulations altered to allow such an industry. Were this possible it would give the fishermen practically continuous employment during the months when they would not be prevented by ice.

I would, therefore, recommend every inducement be offered to convert to useful purpose this waste fish as well as the ever increasing fish waste.

By adopting the units of area suggested, small plants of one digester might be erected at little cost as object lessons say, at Canso in the old lobster hatchery, and another at Clark's Harbour or Tiverton, and another, perhaps, at Grand River. These plants could be operated, I am confident, at a profit, since the all-important raw material is there and the market for the finished product is crying out for it. After operation for a short period, these plants, I feel sure, would be readily saleable as going concerns, were it possible financially to organize them. A market for the finished products of a marketable nature at pre-war prices, of course, would have to be shown.

I do not think that more than dehydration could profitably be done at any of the points mentioned, and, further, it would not be advisable since it is all important that if an industry of this kind were built up the manufactured product should be standardized at some central point.

Meal having the nutritive ration of raw fish meal is a dangerous product to put on the market, particularly in the hands of any one in ignorance of its feed value, to say nothing of its storage capability.

Another point to be borne in mind is that, should an industry of this kind develop as it has on the American Pacific Coast, certain legislative regulations should be put into force in order to protect the consumer of the finished product. First, the insistence of the use of fresh and sound fish waste, free from black fish or whale, porpoise or seal flesh, if converted into feed. Second, if converted into fertilizer, fillers of no economic value should be eliminated or regulated. Thirdly, in either case the analysis should be guaranteed. Fourthly, the period of storage should be guaranteed.

Unless some regulations are put into operation, there are bound to be products of exceedingly doubtful origin put on the market as food, as I have myself seen. If such material would be distributed, it would create a want of confidence and thus a valuable protein and ammonia base would be lost to agriculture.

Were a chain of small dehydration plants along the Atlantic Coast in operation, some central point or points should be selected inland, for standardizing the finished product, according to the requirements of the trades, be they feed, fertilizer or oil. It would be fatal in my opinion to overlook this point, were any large scheme put into operation.

The next point to be considered is the type of plant most suitable. There are three fundamental principles at present adopted, viz., what are known as the continuous, the solvent and the intermittent. The latter is of two types, viz., with direct or indirect steam digestion.

Now, if a high class feed is the product aimed at and a sound, neutral, practically foot-free oil, in my opinion the indirect intermittent type is the best. It is true it is not fool-proof, any more than any other type, but it has the outstanding feature of not being wasteful.

Other questions to be considered are those relating to the special methods of fishing which would have to be inaugurated in order that fish that have not hitherto been taken out of the water could be economically delivered to the reduction plant. At present fishermen have no gear to lift flat fish, and would also require instruction in the use of such gear, were it introduced. I am informed that the plant necessary is to be seen in operation out of the ports of Boston and Gloucester, where fishermen very effectively can collect this type of fish at the least possible cost.

Another point to be considered is the cost of operation. First, the cost of gear to the fishermen, the cost of bins, barrels or hoppers for fish waste collection, the cost of reduction plant, also of compounding, standardizing and refining.

The remaining question is that of organization,—first of the districts, and finally the distributing centre of the finished product to the farmers.

These and many other points connected with the question you did not instruct me to look into, nor have I had the time up to the present, to take them up. You will, doubtless give me instructions further in connection therewith.

In conclusion, let me summarize briefly the points I wish to bring to your notice,—

1. The basis of my survey is on information gained direct from the fishermen, and also on my own personal observation.

2. The conclusive fact that there is an enormous and ever increasing quantity of fish waste, and further, in proportion to the catch there is from 15% to 30% of unmarketable fish at present thrown back into the sea dead.

3. That there are centres of fishing areas where there could be collected waste in sufficiently large economic quantities as would fully justify the erection of a reduction plant; and further, that such plant could undoubtedly be run so as to produce good commercial profit.

4. That the question of collection of the waste can easily be solved in such areas as are under survey.

5. That there is a serious demand for another source of protein owing to the great and increasing scarcity of linseed and cottonseed cake in agriculture, independent of the American manufacturer.

6. That there is ample justification for the erection and operation of an economic unit for demonstration purposes, and that such plant, if erected, should be managed on a commercial basis.

7. That it is desirable to study the best means of distribution of the finished product, whether it be through the trade or the farmer's co-operative societies.

8. That it is essential to standardize the feeds, so that harm cannot be done to live stock through want of knowledge of nutritive values.

9. That it is esential that legislative regulations be framed to protect the consumer of this new feed product.

10. That it is essential that steps be taken to interest private capital and co-operation amongst fishermen to promote this industry.

11. That such an industry does not require a large capital but rather small in proportion to the commercal value of the product.

## APPENDIX P.

## A BILL FOR AN ACT RELATING TO THE COMMONWEALTH INSTITUTE OF SCIENCE AND INDUSTRY.

Be it enacted by the King's Most Excellent Majesty, The Senate, and the House of Representatives of the Commonwealth of Australia, as follows:—

### PART I—PRELIMINARY.

1. This Act may be cited as the Institute of Science and Industry Act 1918.

2. This Act is divided into Parts as follows:—

Part I—Preliminary.
Part II—The Commonwealth Institute of Science and Industry.
Part III—The State Advisory Councils of Science and Industry.
Part IV—Powers and Functions of the Directors.
Part V—Miscellaneous.

3. In this Act, unless the contrary intention appears,—

"Advisory Council" means an Advisory Council of Science and Industry established under this Act;

"Director" means a Director of the Commonwealth Institute of Science and Industry.

"Institute" means the Commonwealth Institute of Science and Industry.

"Officer" means any person employed by the Directors under this Act;

"The Minister" means the Minister of State administering this Act.

### PART II—THE COMMONWEALTH INSTITUTE OF SCIENCE AND INDUSTRY.

4. (1) There shall be a Commonwealth Institute of Science and Industry which shall consist of three Directors and in each State an Advisory Council of Science and Industry. It shall be a body corporate with perpetual succession and a common seal and capable of suing and being sued.

(2) All Courts, Judges and persons acting judicially shall take judicial notice of the seal of the Institute affixed to any document or notice, and shall presume that it was duly affixed.

(3) The Institute shall, subject to this Act, have power to hold lands, tenements and hereditaments, goods, chattels and any other property for the purpose of and subject to this Act.

(4) The Institute shall have power to acquire by gift, grant, bequest or device, any such property for the purpose of this Act, and, in the absolute discretion of the Directors, to agree to any conditions of such gift, grant, bequest or device.

(5) The powers of the Institute under the last preceding subsection shall, subject to the regulations and the approval of the Minister, be exercised by the Directors on behalf of the Institute.

5. (1) The Governor General may appoint three persons to be Directors, of whom two shall be chosen on account of scientific attainments.

(2) On the happening of any vacancy in the office of Director the Governor General shall appoint a person to the vacant office.

(3) The term for which any such appointment is made shall be five years, and every person so appointed shall, at the expiration of his term of office, be eligible for re-appointment.

(4) In case of the illness, suspension or absence of any Director, the Governor General may appoint a person to act as Deputy Director during the illness, suspension or absence, and the Deputy shall, while so acting, have all the powers and perform all the duties of a Director.

6. (1) The Governor General may appoint one of the three Directors to be Chairman of the Directors and on the happening of any vacancy in the office of Chairman of Directors the Governor General shall appoint a person to fill that office.

(2) In case of the illness, suspension or absence of the Chairman of Directors, the Governor General shall appoint one of the other Directors to act as Chairman during the illness, suspension or absence.

7. (1) Each Director shall receive such salary as the Governor General determines.

(2) The salaries of the Directors shall be paid out of moneys appropriated by Parliament for the purpose.

(3) Travelling expenses as prescribed shall be paid to each Director on account of his expenses in travelling in the discharge of the duties of his office.

8. (1) The Minister may at any time suspend a Director from his office for incapacity, incompetence or misbehaviour.

(2) If a Director is so suspended the Governor General may appoint a Board of Inquiry (consisting of three persons, one of whom shall be the Chairman of the Board, and any two of whom may exercise all the powers of the Board) for investigation and report upon the charge of incapacity, incompetence or misbehaviour preferred by the Minister.

(3) If the Director does not admit the truth of the charge preferred against him, the Board of Inquiry shall inquire into the truth of the charge and, after fully hearing the case, shall report to the Governor General their opinion thereon.

(4) If the charge is admitted or is found by the Board of Inquiry to be proved, the Governor General may, if he thinks fit, call upon the Director to retire from his office, and he shall retire accordingly.

(5) If the charge is found by the Board of Inquiry not to be proved, the suspension shall be immediately removed by the Minister.

(6) Save as in this section provided, a Director shall not be removed from office during the term for which he was appointed.

9. (1) For the conduct of business any two Directors shall be a quorum, and shall have, subject to subsection (3) of this section, all the powers of the Institute.

(2) At a meeting of the Directors the decision of the majority shall prevail.

(3) If, at any meeting of the Directors at which only two Directors are present those Directors differ in opinion upon any matter, the determinatiton of the matter shall be postponed until all the Directors are present.

10. The Directors shall devote the whole of their time to the performance of their duties, and no Director shall accept or hold any paid employment outside the duties of his office as a Director, or be a Director of a company.

### PART III—THE STATE ADVISORY COUNCILS OF SCIENCE AND INDUSTRY.

11. (1) An Advisory Council representing science and the principal primary and secondary industries shall be appointed in each state and shall advise the Directors with respect to the affairs of the Institute.

(2) The members of the Advisory Council in each state shall be appointed by the Governor General and shall receive fees and travelling expenses as prescribed for attendance at meetings.

12. One or more of the Directors shall meet and confer with each Advisory Council at least once a year.

### PART IV—POWERS AND FUNCTIONS OF THE DIRECTORS.

13. (1) The powers and functions of the Directors shall, subject to the regulations and to the directions of the Minister, be:—

(*a*) the initiation and carrying out of scientific researches in connection with, or for the promotion of, primary or secondary industries in the Commonwealth;

(*b*) the establishment and awarding of industrial research studentships and fellowships;

(*c*) the making of grants in aid of pure scientific research;

(*d*) the recognition or establishment of associations of persons engaged in any industry or industries for the purpose of carrying out industrial scientific research and the co-operation with and the making of grants to such associations when recognized or established;

(*e*) the testing and standardization of scientific apparatus and instruments, and of apparatus, machinery, materials and instruments used in industry;

(*f*) the establishment of a bureau of information for the collection and dissemination of information relating to scientific and technical matters; and

(*g*) the collection and dissemination of information regarding industrial welfare and questions relating to the improvements of industrial conditions.

### PART V—MISCELLANEOUS.

14. The Governor General may arrange with the Governor of any state for any of the following purposes:—

(*a*) the utilization for the purpose of this Act of state research departments and laboratories and experimental stations and farms;

(*b*) the co-operation in industrial and scientific research with state Government departments, universities and technical schools; and

(*c*) the co-operation with educational authorities and scientific societies in the Commonwealth with a view to—

(i) Advancing the teaching of science in schools, technical colleges and universities where the teaching is determined by those authorities;

(ii) the training of investigators in pure and applied science, and of technical experts; and

(iii) the training and education of craftsmen and skilled artisans.

15. (1) The Governor General may, on the recommendation of the Minister, appoint such officers as he thinks necessary for the purposes of this Act.

(2) Officers employed under this Act shall not be subject to the Commonwealth public service 1902-1917, but shall be engaged for such periods and shall be subject to such conditions as are prescribed.

(3) An officer of the Commonwealth public service or of the public service of a state who becomes an officer under this Act shall retain all his existing and accruing rights.

16. All discoveries, inventions and improvements in processes, apparatus and machines made by officers of the Institute shall be vested in the Institute as its sole property and shall be made available under such conditions and payment of such fees or royalties or otherwise as the Governor General determines.

17. (1) The Directors may pay to successful discoverers or inventors working as officers of the Institute or under the auspices of the Institute such bonuses as the Governor General determines.

(2) Bonuses payable under this section shall be paid out of moneys appropriated by Parliament for the purpose.

18. The Directors may charge such fees and may agree to such conditions as they think fit for special investigations carried out at the request of any authority, institution, association, firm or person.

19. The Directors shall, once in every year, make a report to the Minister containing a summary of the work done and researches and investigations made and proceedings taken by the Institute during the preceding year.

20. The Minister shall cause the yearly report of the Directors to be laid before both Houses of the Parliament within thirty days after the receipt thereof if the Parliament is then sitting, and if not, within thirty days after the next meeting of the Parliament.

21. The Directors may publish such information relating to any matter investigated by them as they think fit, except where such publication would be contrary to conditions agreed to under section eighteen hereof.

22. The Governor General may make regulations not inconsistent with this Act, prescribing all matters which are required or permitted to be prescribed or which are necessary or convenient to be prescribed for carrying out or giving effect, to this Act, and in particular for prescribing such additional powers and duties of the Directors as he deems desirable.

## APPENDIX Q.

## PROVISIONS FOR THE FUTURE CONTROL OF THE NATIONAL PHYSICAL LABORATORY OF GREAT BRITAIN.

1. The name of the Institution shall be "The National Physical Laboratory."

2. The scientific control of the Institution shall be exercised by the President and Council of the Royal Society in the manner provided for in Sections 3-13 of the original scheme as modified by these provisions.

3. The property of the National Physical Laboratory shall be vested in the Imperial Trust for the encouragement of Scientific and Industrial Research.

4. The income of the Laboratory, including receipts from fees, will be vested in and shall be under the control of, the Committee of the Privy Council for Scientific and Industrial Research.

5. The Executive Committee* shall be responsible for the management of the Institution in accordance with the scheme of work and estimate of expenditure referred to below, and shall appoint and dismiss the officials, except the Director. In the case of the clerical staff it may be found conveninent to take advantage of the ordinary Civil Service methods of appointment.

6. The Executive Committee shall present in December in each year to the General Board* a report on the work of the National Physical Laboratory for the current calendar year, and a statement of the work which it is proposed to undertake during the ensuing financial year.

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**Explanatory Note.*—The General Board consists of forty-two members, four of whom are the President, Treasurer and Secretaries of the Royal Society and twenty-four are nominated by the President and Council of the Royal Society. The Executive Committee consists of the President, Treasurer and one of the Secretaries of the Royal Society and eight others of whom six are appointed by the President and Council of the Royal Society.*

7. The Executive Committee shall submit to the Committee of Council for approval not later than January 1 in each year, a report on the work of the previous calendar year, together with a scheme of work and an estimate of expenditure, and they shall carry on the work of the Laboratory in accordance with its provisions.

8. The Director of the Laboratory will in future be appointed and may be dismissed by the Committee of Council, but before making any appointment the Committee will invite the President and Council of the Royal Society to nominate some person suitable for the position, and will consult them as to the appointment to be made. Before making their nomination the President and Council of the Royal Society will consult with the Executive Committee of the Laboratory.

9. The arrangements for finance will be those usual in a Government Department.

10. The Committee of Council will be responsible for any legal proceedings which it may become necessary to institute or defend.

11. The Advisory Council for Scientific and Industrial Research will be the Visitors of the Laboratory.

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# REPORT

~~AGRICULTURE~~

& presidents financial statement

OF THE

# ADMINISTRATIVE CHAIRMAN

OF THE

# HONORARY ADVISORY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH OF CANADA

For the Year ending March 31, 1919

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